Chapter 4
Water as a Socializing Element: Hydraulic Culture in New Spain Between the Sixteenth and the Eighteenth Centuries

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4.1 Introduction

When in the first third of the eighteenth century the Marqués de Aguayo established the settlement of San Antonio de Béxar in Texas, and with it the Franciscan missions meant to indoctrinate and evangelize indigenous groups, he was accompanied by families from the Canary Islands where they were going to apply their knowledge of land cultivation with irrigation. The islands had been a necessary middle ground in the process of expansion of a tradition, which was a consequence of the adaptation of medieval Muslim techniques to an insular context. This is a specific case that we are going to analyse later on and that serves as a closure of the chronologic arch with which we are going to work in this text encompassing the sixteenth, seventeenth and eighteenth centuries.

Controlling water, from its collection, storage and distribution, has historically been one of the greatest achievements of humankind in order to settle in a place. Furthermore, if the territory was of a desert-like nature, this accomplishment turned into a feat. The bond that has been created between Europe and America since the fifteenth century and in the case of the territories that constituted New Spain since the sixteenth century enabled the pouring of experiences that were added to the ancestral pre-Hispanic practices.

The result was a set of traditions, places and instruments necessary to manipulate the liquid element, which has left a cultural mark that nowadays is part of the

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contribution of a country like Mexico to humankind. All of this is the evidence of how the process of settlement and land control carried out by the Europeans was supported by the control of the hydraulic resource based on the necessary utilization of the ancient pre-Hispanic practices and the introduction of techniques and rules of conduct that are deeply rooted in Islamic traditions, which had been defined throughout eight centuries in the Iberian Peninsula and after that they had been adapted to the insular context of the Canary Islands. Their introduction in the American world put in contact experiences that were hundreds of years old and that merged. This complex heritage has become one of the most interesting chapters of the Mexican culture, which represents an exchange that goes beyond its material nature and permeates the immaterial. Today, types of behaviour and knowledge are part of a tradition that needs identification and conservation.

In the concrete case of the desert, water is of paramount importance, given that they are two antagonistic spheres designated as heritage. With respect to documentary evidence, they are the setting and the protagonists of some declarations concerning world heritage where their union has created noteworthy cultural manifestations. The way in which human beings have historically related to the desert, facing and "taming" it, by giving it back its lost fertility thanks to water, is representative of their capacity to overcome challenges.

We consider that this dualism, the indomitable spirit of the place and its capacity to create life, can serve as a way of reflecting about the social dimension of deserts. As a habitable place, it demands that the groups of humans that live in it have strong bonds. Furthermore, it forces them to have a perfect organization that makes the best possible use of scarce resources like water. But also, the meagre presence of water turns it into an object of dispute leading to conflicts over the access to it, affecting the stability of those communities and above all the severe damage of the places they inhabit.

The case of Cuatro Ciénegas can well serve as an excuse to understand the fragile relationship among water, land and humans. The bonds that have been created among these three components along history are really fragile when the public and private domains clash over its use. Inhabited since the pre-Hispanic period, human communities have left an indelible mark on the territory. Cuatro Ciénegas unique pools, as ecosystems with endemic forms of life, face the dilemma of surviving due to the overexploitation of the aquifers that nourish them. Apart from their endemic species, the acknowledgement of their uniqueness may make their conservation possible given the raising awareness of the local communities. A clear example is the formative programme in their schools, which has had one of the most remarkable outcomes in terms of social involvement in heritage conservation.

4.2 Water and Social Dimension

Water is capable of bringing together human beings at the social level and in different degrees. A look over the territories that have incorporated its use shows that

those lands have an interwoven social organization, with close bonds, which are subject to the demands that impose manipulating the liquid to a great extent. Land which is being irrigated in any way is a social space, and that affects all the mechanisms that control the effective use of water, including work relationships. The importance of its control, which involves building the necessary infrastructures to obtain, store and distribute it, also implies the order and the way of having access and using it, turning it into the vital structuring element that demands a strict individual behaviour. Thus, in the context of irrigated lands, communities cannot settle far away from the farmland, since, for instance, they are subject to strict irrigation shifts, cleaning and maintenance of the ditches, etc.

Regardless of the approach we take, the ancestry of the two contexts involved in Mexico, the pre-Hispanic Mesoamerican and the Castilian from New Spain, demanded a clear social organization. In the first case, the concept of the common good governs every action. Besides, in the Castilian case, there is the added value of being the heirs of the Muslim tradition which managed to cultivate monsoon species in territories with hot summers but poor rain, changing in this way the diet on both sides of the Atlantic (Watson 1998). Pre-Hispanic cultures had developed a continuous and autonomous process, only with some regional variations, which proves the long tradition over water control and community organization. This social structure implies a different level of consideration: from the pre-State and State domain, ruled by the basic principle of public benefit in the distribution of infrastructures, to the individual domain, characterized by the community labour necessary to carry out the completion of these works (Rojas et al. 2009).

Apart from its pragmatism, as we have highlighted, water holds an important symbolism. Religion and aesthetics go beyond their meaning, from an almost practical stand to a philosophic and religious status, values which are present not only in pre-Hispanic America but also in medieval and modern Europe. As such, we can find water in the myths of origin and narratives of many of the local peoples that lived in America before the arrival of Europeans. Being agricultural societies, their prayers and pleas were directed towards one of the most important and ancient gods, Tláloc, who is still worshiped on the hills nearby the city of Texcoco (Clavijero 1970). However, water also contributed to the creation of recreational spaces, like the lakes that were part of the property of Moctezuma. From Europe, water management ideas arrived along with a religion and christening, a foundation stone of their massive evangelization.

Finally, we cannot overlook the fact that it also implied a language use that enabled the people in charge of its construction or maintenance to have a precise idea of what was being done. A vocabulary, currently non-material heritage not yet acknowledged, which has its origins in the convergence of the pre-Hispanic and European traditions. Practices, in this case of Islamic origin, whose recollection is surprisingly alive in terms such as *dula* or in organizational practices like those of the irrigation communities from Baja California, who are still solving the problems derived from their use accepting that they are part of the Jesuit legacy (Sorroche 2011).

4.3 Pre-Hispanic Background

The Mesoamerican civilization, which developed with the support of agriculture, had the deity linked to water praised on the top of its pantheon. Societies which progressively defined themselves as farmers and warriors had this liquid element present in their mental, social and cultural structure. In the mythical texts, it is in the centre of the primitive waters where the island that symbolizes the centre of the world as a sacred mountain is located. Similarly, there is a basic concept for their territorial and social organization, which is the *altepetl*, where water and mountain are referred to in its very name (Fig. 4.1) (Bernal and García 2006).

The Mesoamerican context has left us endless examples that let us understand the social demand and the ability to make use of water, which prove that this can only be done in a well-structured community. As stated by Teresa Rojas Rabiela: "This development must be understood as the combination of the prevailing techniques and socio-economic and political forms of organization in the historic period we are analysing in here, so that certain problems like those related to work tools in Mesoamerica, all of them manual, made out of wood, stone and, in some occasions, metal (hard copper), must be interpreted in the specific context of the society where they were being used, with the concomitant workforce politically organised by the State. We are mainly making reference to the systems directed towards applying

Fig. 4.1 Migration of Mexica people from a mythical mountain in the water. Boturini Codex. S. XVI

work to a great diversity of collective tasks, including public and hydraulic works, of course" (Rojas 2009, p. 19). A journey along the 3000 years of history prior to the arrival of Europeans in America illustrates the fundamental role that Europe had in such specific aspects like stabilizing settlements and exploiting farmland (Rojas 2009).

Apart from the material factor, water appears to be a key element within the pre-Hispanic tradition found in codices and traditions that have been passed on from generation to generation to the present day. Key component of a structure that places water as the primitive liquid as we have seen above, in all the cases the necessary social organization that its use demands illustrates the ability to build artificial structures. In this way, really diverse environments have been inhabited, like the watery habitat of Veracruz by the Olmecas, the lakes in Tenochtitlan with the creation of chinampas by the Mexicas, who managed to change the lacustrine territory by building different structures such as aqueducts and *albarradas* or dikes, and we cannot overlook the case of the Hohokam society already in the deserted north, who were always close to their irrigated lands.

This social dimension takes us to another topic, to value the role of the State or the institutions in the creation of these infratructures, as Ángel Palerm has already pointed out when he raised awareness about the fact that irrigation was successful in spaces that had a major people concentration (Palerm 1972, 1973). The cohesive nature of the political operational structure is essential to understand the organizational capacity of periods like the Olmeca, without which it would be impossible to understand the volume of work done during the Pre-Classical Period. During this period there is already evidence of the presence of dams and irrigation canals, infrastructures that demand an internal organization which was inherent to the society and without which the great engineering works, like the construction of artificial islands and pyramids, as in the case of San Lorenzo or La Venta, would not have been possible. Also, the production of monumental sculptures requires an established order and the acknowledgement of social hierarchy that is internal to the group (Soustelle 1984).

During the Classic Period, it has been proved by archaeologists that the organization of the States was able to move great amounts of labour to carry out engineering works. In this way, great water reservoirs had been created, which proved their unquestionable capacity and which reached an utter perfection in their infrastructure works in this period. The canalization of the banks of the San Juan river as it passes by the city of Teotihuacán in a moment of urban expansion, together with an imbricate irrigation system (Manzanilla 2009), the great water reservoirs of Mayan cities like Tikal (Scarborough and Grazioso 2015) or more specific cases, like the cistern that exists in the central square of Monte Albán, illustrate a civil service of the classic State that we should bear in mind.

In the case of the Post-Classical Period, the lacustrine environment of a city like Tenochtitlán and the successful adaptation of the Mexica group demand looking backwards and questioning its origin and its connection to other humid contexts. Also, the organizational capacity to understand the creation of the *chinampa* as a unit in the urban definition of the city and, on the other hand, the very provision of

Fig. 4.2 Chinampas in Xochimilco. Mexico City

services for survival in that place show a perfect adaptation to an aqueous environment. Some of the most salient constructions are diverse aqueducts, such as those of Chapultepec and Acuecuexco in Coyoacán, which brought water to Tenochtitlán, and that of Tocotzinco (Acolhuacan), which is known as "Baños de Nezahualcóyotl" and is the best preserved up to date. The *albarradas* were also outstanding, as dikes or combining their use as roads, necessary for the containment of the waters of a lake, which not only were of a different nature, salt and fresh, but were affected by the rainy season due to the contribution of the basins that supply the lake and that they had to control. The Albarradón of Nezahualcóyotl illustrates what is mentioned above as it is a construction work that managed not only to control the regular floods of the lake but also to separate freshwater from saltwater, benefiting from what each of them offered, irrigation and food.

4.4 European Contributions: The Sixteenth Century

Well into the Colonial Period, water did not only play an important role in the territorial control of the new spaces, but it was also a key element to guarantee the functioning of cities and to begin the exploitation of large land extensions; to this purpose, its private and public use was regulated. As we have pointed out in the case of the pre-Hispanic period, throughout the colonial period water and the building of

infrastructures to control it demanded an important social organization and the intervention of indigenous labour at the beginning.

From the beginning, the water demand by the newcomers was the key to understand the process of the occupation of land. In Castile, the culture of water was already perfectly defined as the heir of medieval Muslim and Christian traditions (Arroyo 1998). Therefore, the objectives were clear: to provide water for agriculture and mining, with the incorporation of new technological innovations, and to supply the population. The transfer of the Castilian legislation as the only resource due to the initial unfamiliarity with the pre-Hispanic regulations turned water into eminent and direct property of the Kings (Birrichaga 2009). The idea that it was a common good let all the inhabitants in a city have free access to it by means of public sources; however, there were various cases in which its private use was regulated: "the private uses of water had been granted to different bodies (indigenous peoples, religious orders and civil institutions) or to individuals by means of royal grants, that is, it was a use sanctioned by a *merced* granted by the King or on his behalf, which guaranteed the right to use a water current or spring; in the event of disputes, these documents were required in order to determine who had the right over the property" (Birrichaga 2004).

The importance of water led to the creation of rules and regulations to optimize its use. Thus, we find the water distribution of 1560, which regulated its use confirming the granted rights by royal concessions or *mercedes*, by which the colonial distributions served as legal justification for the solution of conflicts over the rights of indigenous peoples and Spanish settlers on the use of the waters (Birrichaga 2009, p. 44), and the Ordinances by Philip II of 1573 for the foundation of towns, which indicated the way to distribute water and crop land. The most common pattern was the equitable distribution among the town founders. In spite of this, the inconsistencies in these rules and regulations made it hard to apply the law in the North of New Spain (Birrichaga 2009, p. 44). Not until the end of the eighteenth century, with the foundation of Pitic in 1789, were ordinances that considered water distribution to towns founded subsequently put forward (Fig. 4.3).

With respect to agriculture, the medieval legacy was enduring in that it was a fundamental element to continue the expansion of a set of cultivated plants towards the west of Mexico, species that had previously acclimated to the Iberian Peninsula since the ninth century. These cultivars expanded from Spain to the Canary Islands, where they adapted to a new place, so that from there they took a penultimate step, first on the Caribbean islands and afterwards on the continent, becoming the base of European agriculture in America and later becoming part of the American diet as a common element of Ibero-American culture, including plants like the sugar cane, rice, peaches, oranges, lemons, figs, olives, pomegranates and many more. These plants could serve as food for the new population that was settling in the new territories, and together with them, the necessary means of survival, while the plants and people were adapting to the local environment (Solano 1990): the necessary knowledge and technology for their cultivation travelled with them. This situation has always raised the question as to whether Moorish population also travelled in spite of the royal prohibitions. Given the high level of specialization that was required to

Fig. 4.3 Town of Coxcatlán, or of San Juan Evangelista, and its subjects, of the Diocese of Tlaxcala. AGI, MP-MEXICO, 19

put those systems forward and the lack of knowledge of Castilians about the management and control of the water that existed throughout all al-Andalus, this possibility has always been left open.

Today, this heritage makes up one of the most interesting chapters of Mexican culture, since it witnessed an exchange that goes beyond its material nature, by means of infrastructure, like aqueducts, mills or ditches, and transcends the immaterial sphere, leaving modes of conduct, knowledge and terms as part of a tradition that needs identification and conservation.

However, the changes that took place in the fields of technology and legal organization disrupted the pre-Hispanic dynamics, finally replacing the existing collective equilibrium of social reciprocity, by another one of rights acquired over land property and water use of great significance, which has not prevented us from finding some of these traditions in the present day.

The occupation of the territories that would make up New Spain demanded that Castilians built a whole series of infrastructures that guaranteed the stability of the process of concentration of indigenous population in towns. By the sixteenth century, the descriptions made by the travellers along the road that linked the port of Veracruz to Mexico City described cultivated land with species that arrived from

Europe, crossed by ditches, and this can be proved by the development of the industry in Puebla de los Angeles, where channels and ditches were drawn from the city rivers, like the San Francisco river, so that tanneries, *obrajes*, brick makers and pottery workshops could work (Loreto 2009, p. 57). We should not forget the exploitation of the already existing resources. In the same vein and due to the land extensions and distances to travel, the elements that took part in that process were given great prominence as in the case of religious orders (Espinosa 1998) and the training and knowledge in engineering and architecture that some of their members had. By the last quarter of the sixteenth century, all of the territory that had been occupied by the Europeans had gone through a clear transformation with respect to its exploitation.

This allowed for the acceptance of traditions and systems, as in the case of the pre-Hispanic *albarradas* of which the *albarradón* of Ecatepec is a clear example. This infrastructure, of which there are still remains, incorporated the concept of "dike road" that had been perfected in the context of the lake of Texcoco. But apart from this, others were improved, which were not left unnoticed in the pre-Hispanic period, but which would have diverse formal characteristics and dimensions, as in the case of the aqueducts, when the arch was added, fountains or dams. This is illustrated by the aqueduct built by Padre Tembleque, or all the fountains with which the city of Mexico was supplied, like Caja de Agua, or Laguna de Yuriria, which was put forward by the Agustinian priest, Diego de Chávez, who founded the convent in 1544.

All the cases showed the changes that were taking place, both technologically and socially: "What happened in the field of hydraulics since the arrival of the Spanish to Mesoamerica was much more than just a 'technical change' in which some artefacts and materials (of wood and stone) were replaced by others (metallic), and in which totally unknown machines and species like waterwheels, mills or working animals were introduced. These innovations meant a true 'technological revolution' in the sense that they brought about a new cultural and socio-political system which gave a different meaning to those 'things' and caused new phenomena. This does not deny that metallic tools made it possible to dig wells and water reservoirs (*jagüeyes*, cisterns, wells, underground aqueducts) more deeply, that the waterwheel, the lever, the lathe and the pulley made it easier to pull out the water and lift it, that the animals, alone or combined with wheels (carts, wheelbarrows) made land transport more efficient and 'freed' the *tamemes*/human carriers, and that the arch in aqueducts and bridges made it possible to take the water to longer distances and connect roads more efficiently" (Rojas 2009).

Nevertheless, the changes also started to take place in the fields of social relationships and property, which modified the existing models. Customary law was replaced by the rights legally granted by means of allocation given to newcomers; thus the spoken word was replaced by the written word: "…the substantial changes, those that radically changed reality in technical terms, took place in the socio-political, economic and cultural spheres. In the same vein, in the legal field, one of the biggest changes took place with respect to the rights over water; in the socio-organizational sphere, in the *coatequitl* […] or collective and compulsory work system carried out in the pre-Hispanic period by ordinary people in order to build and

maintain hydraulic works and public works in general. The ones and the others caused endless legal and ordinary conflicts among the Europeans and the indigenous populations. The owners of mills, *trapiches,* sugar mills and fulling mills that had been granted royal *mercedes* acquired the property of the land and the right to use the water to move their machinery or irrigate their fields. Sooner or later, this disrupted the functioning of Mesoamerican hydraulic systems from the technical point of view, but not only that, it also changed the meaning of the whole sociopolitical organization that made them work (construction, maintenance), nourished by the sense of collective use and social reciprocity" (Rojas 2009).

4.5 The Seventeenth Century

The seventeenth century is characterized by the continuity of what had been started in the previous century. What is more significant is the attempt to control new territories that were being integrated after the expeditions supported by the viceroys. They had to reinforce what they had already gained before the threat of European powers that were trying to settle on those spaces which were not directly controlled by the Spanish Crown. In any case this was a complex century, in which the crisis that affected Spain travelled to America, where there was a progressive power loss after the death of Philip II in 1598, which Philip III, Philip IV and Charles II could only slow down.

As in the sixteenth century, the chronicles written both by the religious and the military are an essential source of knowledge of how the conflicts over natural resources between European settlers and indigenous populations intensified. Nearly all the aspects of New Spain were detailed. For example, in this century, the *Demarcación y Descripción de el Obispado de Michoacán y Fundación de su Iglesia Cathedral…* by Francisco Arnaldo Issasy serves as an example in which populations are being described in great detail concerning their ecclesiastical architecture, including in some of them references to fountains and water distribution (cited by Ettinger 1999).

The disputes to control the volume of water of *aguajes* became frequent, bringing to light the problems related to the access to a resource that in some northern areas was starting to be scarce. Expeditions, especially to the north, were intended to find routes and consolidate a presence that was becoming increasingly threatened by the more peripheral spaces of the coast of California or the Mississippi basin. They were made up by soldiers, missionaries and civilians, and their routes were plotted on the basis of the information and experiences of the indigenous people that went with them and that turned *ojos de agua* and *aguajes* [refers to springs and small dams] into fundamental elements in their routes and later into the foundation of settlements, be them villages, missions, mines, etc. In the seventeenth century those settling processes became consolidated, since some missions were turned into churches becoming real towns, where their urban outline was being developed at the same time as in the cities. This was a new period, and this is also illustrated to some

extent by the fact that the dynamics are no longer led by the Spanish but by people from New Spain.

The panoramic view that New Spain offers in the seventeenth century shows that the new creole society had already settled and where the necessary infrastructures for production were one of the many features of the scenery. By 1622, in the coast of Veracruz, the descriptions made by travellers and passers-by show us that this hot land hosted some settlements inhabited by indigenous people among its towns. It also had a coastal area called "the plains of Almería", where the cattle ranches and *haciendas* founded by the Spanish had been settled along sugar mills, lands cultivated with corn, tobacco and other seeds spread across the whole territory.

If in the previous century the process of getting into contact had taken place between the arrival, occupation and perception of the new reality that had to be dominated, during the 1600s the changes were more radical. This was not only due to what has been mentioned but also for the institutionalization of a new way of land exploitation, the hacienda, which had started being implemented in the continent in the mid-sixteenth century. Without a doubt, the changes that had taken place in the management of water, which until the previous century were clearly controlled by indigenous institutions and had gradually been set aside or transformed in their essence, had been accelerated due to technical innovations. Illustrated in the new machinery put to the service for land exploitation, this had a clear impact on the changes in the use of soil, even in the reduction of the extension of irrigation lands, which decreased in favour of extensive lands for the cultivation of cereals or the introduction of livestock, a non-existent component before the Europeans' arrival. Overall, in this century the acclimation of species that had arrived in America in the previous century is evinced, and it is interesting to notice how fruit trees, as citrus, bananas, pears, apples, plums and walnuts, are numerous in the descriptions of the territories of New Spain that are made in this period.

As mentioned earlier, the presence of those *haciendas* was added to the increasing number of mills, *trapiches* and fulling mills, illustrating the changes that started to take place since the sixteenth century. The scenery was sprinkled not only by these new components but also by some changes on the surface of grazing lands which competed with those of irrigation. Such a duality even made that the towns which were further from the outskirts of urban contexts were the ones which later perceived the change in the use of land or the water access from springs. In some way, the great protagonist, *la hacienda*, was positioning itself as the great organizing centre of the farming space, reassuring a hegemony that would last even until the twentieth century (Fig. 4.4).

But it was also a moment in which disputes between the Spanish and the indigenous people became frequent. These confrontations even led to the destruction of ditches and dams. The medieval right of *mercedes* and the indigenous customary law clashed with respect to water use and the need to irrigate the lands that the indigenous people had. In the case of Querétaro, by the beginning of the seventeenth century the situation worsened due to the fact that the Spanish took over the best properties, which demanded a greater amount of water.

Fig. 4.4 Dam and ditch in the mission of San Francisco Javier Biaundó. Baja California. Mexico

The situation in this city illustrates the moments of tension and decline of traditions. On the one hand, due to the fact that the urban population was a mixture of indigenous people, mulattos and Spanish, the use of water from ditches that crossed the towns was complex, but above all, due to the controversies that arose due to the limitations the viceroys established over the use of water and irrigation, because water belonged to the indigenous people since the foundation of the towns. By the middle of the seventeenth century, the problem was already present, and as it can be seen in a document from the year 1640: "…and on behalf of all the other settlers in the neighbourhood of the Mexicans from Santa Cruz of this town as our right, we claim that in order to support ourselves and our wives and children, provide them with the basics and pay the royal tribute we have in our houses and out of them some sort of lands with fruit trees and tillage land where we sow maize, wheat and other seeds that need irrigation that belongs to us as naturals to the River of this town since we have used it since its foundation and now it is being disturbed by *mayordomos* and landlords and other people that perform the works they called Jurica and of Santa María and others that are on that other part of the River breaking the dam to take it against our will" (Loyola 1999, p. 119).

4.6 Epilogue of the Eighteenth Century: The Control of Northern Desert Areas

By the eighteenth century, the territories of New Spain have reached their utmost extent to the North. The remoteness of the decision centres somehow led to the dependence on the autonomy attained by the control over water and the exploitation of the agriculture and livestock lands. Against that general background, the examples that can be found are those of overcoming the environment, becoming more and more desert-like, and those of indigenous groups that besieged the Spanish outposts. A vast territory coveted by European Powers and, later on, by Russia and the USA.

We will take as reference one of the examples that can serve as a framework for understanding the socializing role of water in these confines and on which we have been working for years. Previously, a hybrid legislation filled a legal gap of more than 200 years, dating from Viceroy Antonio de Mendoza's *Ordenanza sobre medidas de tierras y aguas* of 1536, and two documents of the second half of the eighteenth century, *The Royal Decree in which H.M gives instructions on how to solve mercedes and sales of Crown properties and wasteland in charge of Excmos. Viceroys and Presidents of the Royal Audiences* of 1754 and the *General Regulation of Water Measurement*, published in 1761, which comes into force in 1783.

4.6.1 The Case of Baja California

The history of the occupation process of the strip that currently comprises the Mexican peninsula of Baja California developed from the 1530s, with Hernán Cortés's first attempts and the South Sea expeditions, and the mid-nineteenth century, with the settlement of the last Missions in San Francisco Bay context (León Portilla 1985). Between those two dates, numerous chapters in which intrepid expedition members played a leading role enabled the configuration of an ever-closer image of the reality that was being pursued, imitating on the coastline what was happening inland (Rodríguez et al. 1995; Rodríguez 2002). Sebastián Vizcaíno noticed the strategic importance of the region, as described by Clavijero (Clavijero 1970, p. 77). At the end of the seventeenth century, Isidro de Atondo y Antillón and Father Kino's expeditions laid the foundations for a period that had been initiated by the Jesuits and would determine the subsequent events.

In view of the characteristics of the territorial articulation, different stages can be distinguished in this historical context. A first stage lasted until 1697, when the Baja California peninsula involved merely a peripheral occupation of the area. In this period the initial difficulties of the process became evident, due to the harsh geography and extreme weather conditions. This is also the moment when the image of its geography is shaped, a geography that will have considerable importance in the

definition of the peninsular reality of Baja California and would affect the supply proposals from the coast on the opposite side of the Gulf of California, both by sea and land.

The second stage was marked by the foundation of the Jesuit missions and which we will roughly delimit from the foundation dates of the first mission in 1697 and the expulsion of the Jesuits from the New Spain territory in February 1768. A new missionary model characterized by the remoteness of the decision centres was defined, and has been studied thoroughly by historian Ignacio del Rio (Rio 2003). During this stage, the mission became the territorial occupation cell, a tool in a process in which the civil and military element had a delimited space but not with the determination of the religious one. In this case, the choice and location of the missionary centres were determined by the inland peninsular expeditions, taking into account the information provided by the indigenous groups, in which the reference to water points and the existence of lands that could be cultivated were vital (Baegert 1989). However, the level of difficulty was such that it took a long time to define a process with guarantees of permanence and that would lead to a process of structuring in *cabeceras* and *visitas*, the same way the central area of New Spain was organized in the sixteenth century (Espinosa 1998). In the first stages of the occupation process, the news in relation to the changes in location of the missionary settlements mainly because of the lack of resources to supply the populations like water is frequent.

The third stage begins with the expulsion of the Jesuits and the arrival of the Franciscans and Dominicans. The decision of the Spanish Crown to consolidate its control over this coastline once and for all meant that the new foundations were arranged on the coast, reassuring the role of border and hence with a double function, religious and political, which actually they never lost. This stage was led by the Dominicans and determined by the need to manage the abandoned missions and complete the articulation of a vast territory comprising the last Jesuit foundation, Nuestra Señora de los Ángeles, and the first Franciscan mission already on the present US territory, San Diego de Alcalá. By agreement with the Franciscans, the Dominicans will be granted the Jesuits Missions in Baja California and will be asked to complete the central stretch of the itinerary that should conform the Camino Real of the Missions (the Royal Road), from the nucleus constituted by the Franciscan foundation of San Fernando de Velicatá area, well known by the indigenous peoples (Nieser 1998; Meigs III 1994). In this case, the environmental conditions marked a division between the Dominicans' peninsular foundations and the Franciscans' in present US California.

The truth is, as stated before, the methodology applied by the Jesuits in Baja California thrives on the one defined by the Franciscans in the sixteenth century in other contexts of New Spain. Supported by the knowledge to act principle, but without the Jesuits' self-sufficiency, Franciscans differentiated from the Jesuits in that they looked for remote places where to carry out their utopian plans and for which they needed the least interference possible (Espinosa 2011, pp. 79–112). Together with this, from 1697 on, the collection of letters between the different fathers that took part in this episode reveals the strategic political and religious character of the penetration process.

An analysis of the Californian geography enables us to understand that the access to water was different, depending on the region. Thus, while there is abundance and stability of sources and courses in American California, the scarcity of water is predominant to the south. In this context, the identification of a water spot was crucial from the outset in which efforts were made to establish stable settlements at the southern end of the region, being essential for human supply and the irrigation of land through a system of storage and distribution. An example to understand this matter is the context of the territory controlled by the Dominican Mission of Santa Catarina in Baja California, in which the *cabecera* and *rancherías* nearby are located next to a water point. This dynamic, essential to guarantee the success of the missions, was already applied before the missionaries' arrival. The existence of indigenous place names allusive to water elements is a clear proof of that and is registered in Father Nicolás Tamaral's report in relation to the state of the Purísima Mission, for example, Santa Catarina's mission's name, *Jactobjol*, means "place where water falls over stones" (Río 2000).

In the process of arrival and occupation of the Californian territory by the Jesuits, Franciscans and Dominicans described in different sources, the need to locate fertile arable lands, pasture for livestock and, mainly, stable water sources to guarantee supply for the population and land irrigation is evident. Although the constituent elements are practically the same, the constructive guidelines are diverse, prioritizing the construction of some elements over others, depending on the field we are referring to (Rodríguez et al. 2003).

The hydraulic infrastructure on which they relied, and which some of the Baja Californian missions still have, although its components show some homogeneity, presented variations in relation to the materials, the nature of the water source they thrive on (e.g. stable *aguajes* or streams with sporadic currents whose water is retained in dams), distance from the cultivated lands and the orography itself, which in a way affect, among others, the construction systems, the number of components and their distribution (Ruiz and Sorroche 2014).

From the three orders, the Jesuits' missions offered better quality and a more complex repertoire, with proportions only rivalled by the Franciscans in the North, although the number we got of these latter systems is smaller. The same does not hold true for the Dominicans, which had more humble characteristics of the constituent elements, construction and irrigation, as perceived both in their dimensions and in the materials with which they were made. In any case, it is one of their most salient heritage items, not only because its presence can still be perceived due to its dimensions but also because the hydraulic infrastructures are still working in some of them, constituting the base of a historical memory supported by some traditional systems of land exploitation.

From the group of infrastructures, we can differentiate between dams and dikes (we use both terms, as they have appeared indistinctively in the consulted sources as in the field work done; they make reference to the structure used to retain water and derive it into a canal), *albercas* or cisterns, ditches, between which we can differentiate dirt and manufactured ones, and finally other elements such as *partidores.* In relation to dams and dikes, they possibly represent the most spectacular group the

missions rely on. They appear in those in which the sporadic aspect of the water source, generally temporary river flows from which they have to be supplied in the best way, demands to be slowed down before being distributed. They also appear in those places with a stable water source which needs to be collected before being distributed. They are located in the proximities of the mission as well as in what we can call their population nucleus, always with the common denominator of being higher than the lands to be irrigated and at an adequate distance to determine the overall irrigation surface. The relevance that entails the alteration of any of these elements was revealed in Texas in the twentieth century (Glick 2010).

Dams and dikes are made of masonry with mortar, illustrating the constructors' clear knowledge of hydraulics. This is made evident in their design, as well as their location, endowing them with the sufficient consistency to withstand the passing of time and the harsh environmental conditions, which were the main reasons of destruction as occurred in the reconstruction of the Jesuit Missions in 1770. Together with this, their complexity varies. Possibly, the Santa Catarina Mission will stand out as an example. Organized in two points separated from the valley where they were located, three dikes stood, two in a first backwater, on the highest area, and a third one in a lower position and near the population nucleus. Made out of different materials, the first ones are considered the oldest ones and represent an example of the need to rationalize the water, once it was demonstrated that the calculation done to measure the irrigation did not cover the expectations to both supply the population and the irrigation of lands (Meigs III 1994).

From the group of missions, the ones which still preserve their infrastructures are the missions of Todos Santos, San Luis Gonzaga, La Purísima, San Francisco Javier Biaundó, Santa Rosalía Mulegé, San Ignacio Kadakaamang and Nuestra Señora del Rosario de Arriba, and from the rest of the infrastructures only the news of their existence remain (Meigs III 1994). In addition, there are numerous remains of the presence of contentions and distribution dikes, which we have little testimony of to have a slight idea of their dimensions and locations (Fig. 4.5) (Meigs III 1994, p. 136).

The news we got of the Jesuit missions allows us to know the state of the infrastructure during the Jesuit period as well as after their expulsion. The chronicles written by the Jesuits after their exile let us rebuild some areas of the Jesuits' irrigated land. Also, the reports commissioned to the Franciscans together with the letters that other members of the Franciscan Order interchanged, such as the ones Father Palóu wrote in 1772 within the inventory process of the missional possessions, complement the first group of sources. In the case of the Dominicans, some expeditions at the beginning of the twentieth century serve as the most appropriate reference to understand their state up to that date. Nieser (1998) and Meigs III (1994) works serve as reference.

Regarding the Franciscans, most sources describe the missions in Alta California in a basic way, and the available data is vague, so it is unsurprising that in the case of the missions founded by Father Serra, the information is exiguous; see, for instance, Clavijero (1970).

Fig. 4.5 Water sources at the Hacienda de San Juan de Sabinas. Coahuila. Mexico

In relation to San Francisco Javier Mission, the components of its hydraulic structure were described (Palóu 1994). The Purísima Concepción de Cadegó Mission in 1772 had an important area that could only be exploited if there was a dam that controlled the water of its stream (Palóu 1994, p. 219). In the case of the former, Father Ugarte's foundation process stands out as he situated the settlement based on the location of a stable water point found with the help of Yaqui Indians brought from the surrounding coast (Barco 1988, p. 257). As for the Purísima, a process of relocation due to the characteristics of the first settlement took place, as described by Father Barco (Barco 1988, p. 260).

In mission of Guadalupe, as in mission San Francisco Javier, the reports from 1772 describe the options to back down the water and lead it to the farmland (Palóu 1994, p. 220). This system not only applied in the *cabeceras* in built-in points that could offer optimal characteristics for farming, for example, the already mentioned San José de Gracia, which depended on this mission (Palóu 1994, p. 221).

The damage caused by heavy rains and resulting floods, for example, in 1770, affected all missions. These include some of the most important infrastructures that still remain in Baja California, such as Santa Rosalia Mulegé dam. This is one of the most spectacular environmental complexes because of its characteristics and dimensions: a huge palm grove generated from the control of water of the wetland, giving rise to the current oasis. When the dam was destroyed in 1770, the Franciscans reconstructed it (Palóu 1994, p. 222).

Another mission that has left an outstanding group of hydraulic structures is San Ignacio Kadakaamang, already reported in 1772 (Palóu 1994, p. 224). The dam that slowed down the water flow is one of the most salient elements, and from its sides a group of ditches branched out to irrigate the whole extension of land, in part occupied by the palm grove and at the back of the church.

Finally, the only Franciscan foundation in Baja California, San Fernando de Velicatá, had a dam that helped slow down the water flow necessary for irrigation, as described by Palóu: "It is founded in a small valley in whose centre a stream runs with sufficient flow to irrigate the land in its meadow, and was easily obtained with an earth and stone dam built in that stream, with which the water was slowed down" (Palóu 1994, p. 230).

Regarding the Dominican missions, Nuestra Señora del Rosario de Arriba mission stands out, still preserving the remains of its dam in the proximities of the nucleus of the first of the two missions that would spread in a big valley that conforms, from east to west, one of the main penetration routes from the coast into the interior.

When the flow of the water source is permanent, the options to collect it vary, from the creation of a cistern for storage, as in the case of San Borja and some *ranchos* near the missions, such as the Dominican Santo Tomás, where we find permanent *aguajes* that were initially stored before being distributed, to the option of direct canals, taking advantage of the quantity and permanence, for example, the case of San José de Comondú or Santo Tomás which, due to their characteristics, will be mentioned in the section of ditches. The San Borja cistern is one of the most common cases that can be found in the missions, but the largest in size, that along with the dams, showcases the huge work and organization capacity that was available for their construction.

The surviving infrastructure examples enable us to extrapolate a model that varies in its dimensions. Overall, they are square or rectangular base receptacles, placed in the water source or along the ditches, which in some cases still retain the remains of the *almagre*, with which the interior of their front was covered. Their capacity varies in relation to the water supplied by the source or *aguaje*, the number of people to supply and the land surface to be irrigated. In some cases, they are of modest dimensions but enough for irrigation. Those of monumental proportions illustrate the importance of water and of the cultivated land; in either case, the ditches start from the source.

Water deposits spread in the cultivated land and along the ditches represent a variant. An example of this is mission San Francisco Javier, in charge of collecting the water for irrigation as the last stage before going back to the riverbed, as stated

in the Franciscan reports of 1772. In this sense, there exist many similar references in relation to Jesuit missions. In the case of the Guadalupe mission, lime sinks were used as complement of the hydraulic system to irrigate small orchards (Palóu 1994, p. 220).

San Francisco de Velicatá complex stands out within this group of water deposits of large dimensions. Approximately located a kilometre from the nucleus of the mission, the storage cistern is placed higher than the crop lands. From it, the water canal carries the water to the proximities of the central building (Barco 1988, p. 340). The distance between the water deposit and the mission shows the ability to adapt the supply conditions to the evangelization, providing the centres with the necessary resources despite the long distance. The remains of El Descanso mission in the state of Baja California up to the present day are remarkable. This Dominican mission was dependent on the San Miguel mission, which the former replaced at a specific moment due to a reduction in the number of indigenous people of the latter. The distinctive feature of El Descanso lies in that it is the only one in which the orchard that supplies the mission is located 5 km into the valley from the coast, near the *ojo de agua* that supplies it, doubling the distance between the main nucleus and the crop lands from other missions in Baja California. The weather conditions account for this unification, in a context in which mists predominate throughout most part of the year, hindering crops. The remains of the irrigation system up to the present consist of a water deposit and a ditch, by which water was distributed, and were supplied from a spring that had been deviated (Meigs III 1994, p. 198).

Within this group of missions, two examples are worth pointing out due to the exceptional ruins that remain today. On the one hand, a pair of small *albercas* situated in Santo Domingo mission, and embedded in the irrigation system from where they took water, were destined to otter skin tanning, which they traded with Russian and English people in the region (Meigs III 1994, p. 137). Hidden next to the terracería nearby, they represent the only example recorded to that aim. On the other hand, the remains of a water deposit constructed like a well made of brick that stands in San Buenaventura mission is the only example reported with these characteristics.

The ditches situated around these missions represent the most complex framework for its dimensions and the direct implication of their location, distribution and exploitation of land. Built with different techniques, such as directly dug into the ground, carved out of rock or made in masonry filled with mortar and covered, in some sections, with flagstones, they are the genuine arteries through which the water reaches every single plot. Locatable in every mission, the ditches exemplify in every case the perfect knowledge of the necessary engineering mechanisms to bridge the distances and fix uneven ground with the aim of making land arable for missional supply. They branch from the dikes in which the water is slowed down, from the cisterns where water is stored or directly from the *aguajes* or sources. As for the first ones, they have been diverted from the mainstream to outline the path through which the water reaches the crop lands from a higher level. In some cases, when the land has a significant level difference, aqueducts are used to keep the route.

In the case of the aguajes, water is directed straight to the ditch, simply diverted with stones. One of the best examples is the layout of the San José de Comondú ditch. Their route is determined by the uneven surface and the distance to bridge, so it is necessary to run along the perimeter of the cultivated land, taking advantage of the gravity to move a quantity of water that must be regulated to avoid the force to be excessive and generate erosion in the channelling system or in the crop plots.

The different sources that have been mentioned cite them as zanjas. Always related to the *aguaje* they nurture from or the dam that regulates the current of water, and in most cases they are the main element described to reference the initial community works destined to provide supply to the missions.

As regards the Jesuit missions, all of them offer an important set of ditches that still fulfil their function. Not all of them have been recorded in the sources, but field work would enable the reconstruction of some of the historical extensions of the crop lands organized by the religious. Cases like La Purísima, San Francisco Javier or San Ignacio, for example, whose land boundaries can still be identified through resources developed by the new technologies, such as aerial photography, show the dimensions of these systems. From some of them, there exists the building document of the first infrastructure, such as Santa Gertrudis mission, whose process was described by Father Barco, and where the scarcity of water led to the canalization of an *aguaje* that guaranteed the supply, narrating the process of gradual improvement of the infrastructure (Barco 1988, p. 285). From the reports by the Franciscans in 1772, Palóu states that San José de Comondú mission had an *ojo de agua* from which water was extracted through a *zanja* (Palóu 1994, p. 218). The typology of ditches that can be identified vary from the channelling dug in earth to the ones arranged in vertical stone walls that were directly carved in the rock. The complexes of Todos los Santos, Santiago de las Coras, San Francisco Javier San Ignacio or San Luis Gonzaga stand out. In the case of San José del Cabo, the urban pressure has practically wiped out its vestiges.

4.7 Conclusions

Access and use of water have always been a limiting factor in the process of occupation of a territory. The convergence of New World and Old World traditions in the Americas since the sixteenth century can be considered in a series of stages that the traditional chronology arranges in a logical succession of centuries.

By the sixteenth century the European arrival to unknown lands is illustrated by the very ignorance of their extensions, and the cirumstances led to the exploitation of the resources already available. The time gap between the acclimation of the techniques and vegetables brought from Europe and that had already got to the Canary and Caribbean archipelago required the indigenous experience in the continent. There is no doubt that the implementation required the resources already known, and for this reason even medieval legal principles were transferred to begin the dynamics of occupation.

The transformation was evident in the seventeenth century, when the interests of colonists and indigenous people clashed over the access to the use of a resource, whose private and public use have seen the replacement of the pre-Hispanic principles by the Europeans' "newly acquired" rights. The constant disputes illustrate this.

The eighteenth century consolidated the expansion that started in the previous century. The principles of rationalization implemented by the Bourbons in the management of the territories they governed, typical of the Enlightenment affected their reorganization and land exploitation. The construction of infrastructures for that purpose, in which hydraulic ones became essential, enabled the installation and occupation of spaces far from the decision centres and that looked for autonomy in a hostile environment.

This text only reveals the tortuous path that water control has traversed in Mexico since the times of the New Spain and how the clashes over its use and the main role of the occupation of spaces have been constant. The moral is that both circumstances led to opposing outcomes that can be applied to Cuatro Ciénegas. If in the first case, the confrontations limited the access to an essential asset of part of the population in Mexico, causing disputes, its rational exploitation facilitated the conquest of lands were the settlers found resources to stock up. A balance between them both might well be a bet on the management of this privileged territory in the North of Mexico.

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