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Coyotes, Concessions and Construction Companies: Illegal Water Markets and Legally Constructed Water Scarcity in Central Mexico

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ABSTRACT: Many regions of (semi)arid Mexico, such as the Valley of Toluca, face challenges due to rapid growth and the simultaneous overexploitation of groundwater. The water reform of the 1990s introduced individual water rights concessions granted through the National Water Commission (*Comisión Nacional del Agua,* or CONAGUA). Since then, acquiring new water rights in officially 'water-scarce' aquifers is only possible through official rights transmissions from users ceding their rights. With the law prohibiting the sale of water rights, a profitable illegal market for these rights has emerged. The key actor in the water rights allocation network is the *coyote*, functioning as a broker between a) people wanting to cede water rights and those needing them, and b) the formal and informal spheres of water rights allocation. Actors benefitting from water rights trading include the coyote and his 'working brigades', water users selling surplus rights, and (senior and lower-level) staff in the water bureaucracy. The paper concludes that legally constructed water scarcity is key to the reproduction of illegal water rights trading. This has important implications regarding the current push for expanding regularisation of groundwater extraction in Mexico. Currently, regularisation does not counter overexploitation, while possibly leading to a de facto privatisation of groundwater.

KEYWORDS: Water rights, water markets, groundwater concessions, water scarcity, Mexico

INTRODUCTION

The Valley of Toluca is a paradigmatic illustration of two characteristic features of Mexico's development during the last two decades: urbanisation and water resource overexploitation. First, the valley underwent the tremendous scale and pace of industrialisation and urbanisation that many regions in Mexico have experienced in the course of the neo-liberal restructuring process introduced by Mexican governments since the Salinas administration (1988-1994). While the growth of Mexico City has slowed down since the 1990s, medium-sized cities now exhibit high growth rates. Toluca, the capital of the Federal State of Mexico (*Estado de México: Edomex*), is located at the west of the metropolitan zone of Mexico City at the foot of the volcano *Nevado de Toluca*, and has been undergoing dramatic changes. Between 1960 and 2010, the population increased from about 300,000 to 2 million inhabitants (Secretaria de Desarrollo Urbano, 2011; Edomex, 2012). The boom started with high in-migration following the establishment of industrial zones along the Toluca-Mexico highway in the 1970s, intensifying after the earthquake in Mexico City in 1986 and with the economic restructuring in the 1990s.

In the course of only about three decades, the valley experienced a change involving the steady retreat of agriculture to becoming a highly urbanised and industrialised metropolitan area. Where there were still cornfields and volcano-fed water lagoons up to the 1990s, there are now urban settlements, large economic production zones with national as well as transnational industries, huge shopping malls, four-lane highways and concrete road-bridges. A distinct visible feature of urban growth in Mexico in the past decade has been the construction of large-scale social housing colonies through private real estate developers ('construction companies'). Social housing, in the form of suburban housing colonies

financed through state-subsidised mortgages for the working class, has played an important role in the emergence of the new water rights allocation regime since it created a boom in the demand for water rights.

Second, large parts of Mexico are facing basin closure (Molle et al., 2010), characterised by the overexploitation of surface water and groundwater, and increasing water scarcity. Of Mexico's 653 aquifers, 101 were officially overexploited in 2012, with the latter accounting for more than half of total groundwater use in the country (CONAGUA, 2012a: 48). The Valley of Toluca is located at the most upper stretch of the Lerma-Chapala Basin, which officially has the highest level of water stress of all Mexican basins (CONAGUA, 2010: 14). Starting with the 'agricultural conquest' of groundwater resources in post-revolutionary times (Wolfe, 2013: 7), the basin was a key region for implementing the 'hydraulic mission' of the Mexican government (Turton, 1999; Wester, 2009: 10; Wester et al., 2009b: 395).

According to official CONAGUA data, one of the highly overexploited aquifers in the basin is the aquifer of the Valley of Toluca. It is difficult to determine the exact extent of overexploitation, since both detailed hydrological studies and data on water extraction are deficient or lacking. It has been estimated that the yearly extraction in the Toluca aquifer is around 495 million m^3 (Mm^3) with a regeneration capacity of about 376 Mm^3, creating a yearly deficit of around 172 Mm^3 (Calderhead et al., 2012). Officially, the regeneration capacity lies at 282.2 Mm^3, the extraction at 422.4 Mm^3 – pointing to a yearly deficit of 134.2 Mm^3 (DOF, 2013b). There are officially 767 wells in the Valley of Toluca, with an average depth of 200 m. The depth of new wells in the industrial zones is up to 600 m. Hydrological modelling has shown that pumping is the major reason for falling groundwater tables in the valley, with climate change playing only a minor role in the increasing deficit (Calderhead et al., 2012). Groundwater tables have been falling rapidly at a rate of about 1 m per year (Klett, 2006: 1).

In response to groundwater overexploitation and challenges in surface irrigation management (Rap and Wester, 2013), a major legal and administrative change from water resources *development* to water resources *management* was implemented in Mexico from 1988 onwards. It involved the creation of the National Water Commission (CONAGUA) in 1989 and the adoption of a new water law, *Ley de Aguas Nacionales* (LAN), in 1992. The 1992 LAN follows international standards of good water policy, introducing a change from 'harnessing' water to an approach that seeks to balance supply and demand through regulatory, economic and participatory management instruments. Particularly important is the introduction of individual water rights concessions granted through CONAGUA.

This paper contributes to an assessment of the water rights allocation regime that has followed the water management reform taking place since the late 1980s. As I will show, the increasing regulation of groundwater extraction via concession titles has resulted in an illegal water rights market, which emerged in the context of Toluca's fast development, in particular the transfer of social housing construction to private real estate developers. There is evidence that the Valley of Toluca is one of the central stages of this 'black market' (*mercado negro*), which evidently also exists in other officially 'water-scarce' zones of Central Mexico, such as the Valley of Mexico (City).

The central actor of the illegal market network is the *coyote.*[1] He[2] has the cultural and social capital to function as a broker between people wanting to cede water rights and those needing them, while at the same time making the process look like a non-monetary transaction, despite payments being in fact made. Water users who were assigned large volumes of water in the reform period, in particular large-scale farmers, sell their surplus rights via *coyotes* in the illegal market. However, the network of actors who extract economic benefits from the illegal market not only includes the *coyote*, his 'working

[1] For a general account on the role of the *coyote* as facilitator of informal market exchanges in the Mexican state apparatus, see Adler Lomnitz (1988: 5).

[2] To my knowledge, *coyotes* are invariably male.

brigades', and users selling water rights: the study reveals that senior as well as lower-level staff in the water bureaucracy play key roles in the *coyote* network. The state is thus also involved in the illegal water rights market.

The findings have important implications as regards the current push for increasing regularisation of groundwater extraction in Mexico, and the impact of the water rights regime on ecological and social sustainability. First, regularisation constructs groundwater scarcity through legal means, and may potentially extend illegal water rights markets throughout the country. Second, the water rights regime does not automatically work against groundwater overexploitation. In contrast, the analysis shows that current groundwater governance as found in and around the Valley of Toluca works against ecological sustainability. Third, current policies aiming at groundwater regularisation, combined with illegal rights trading, may lead to the increasing establishment of clearly defined property rights in groundwater. Such developments could result in a de facto privatisation of water – even when water is legally a common property.

The paper draws on field research done in 2006, 2012/2013 and 2014.[3] Semi-structured interviews were conducted with federal and local government officials, private companies, and farmers. The findings are largely based on research in the Valley of Toluca, but also include data from the Valley of Mexico, as well as secondary data. The details of the functioning of the 'black market' for water rights draw, to a large extent, on several interviews with an insider, and participant observation. Interviews and field notes were coded and analysed using qualitative data analysis software.

LEGAL FRAMEWORK: WATER RIGHTS CONCESSIONS, ZONAS DE VEDA, AND WATER RIGHTS TRANSMISSIONS

The key structural change creating the illegal water rights market was Mexico's 1990s water reform, which introduced a system of individual water rights concessions. Mexico's water reform has attracted much attention internationally, since it is one of the countries where ideas about 'good water management practices' discussed on the global policy level were actually translated into national legal and administrative structures, especially in terms of irrigation management transfer to water user groups (Garduño, 2005: 90; Rap, 2006; Wester, 2008; Wilder, 2010; Rap and Wester, 2013). The reform was based on a shift in international water policy in the 1980s, away from a supply-oriented approach of water resources development towards a demand-oriented approach, with emphasis on institutions and economic and social instruments for water management (Perret, 2006: xxi). It took place during the break-through of neo-liberalism, which had been on the rise in Mexico since the 1970s (Morton, 2003) and was promoted and partially financed by the World Bank (Wilder, 2010). One of the first legal acts of the Salinas presidency involved the creation of the National Water Commission *Comisión Nacional del Agua* (CNA, later CONAGUA) in 1989, a federal state organ now under the Ministry of Environment and Natural Resources (SEMARNAT)[4] and the sole responsible for water resources planning, management and development. CONAGUA is responsible for the implementation of the water law, i.e. the regulation of water extraction and distribution, and the preservation of the quantity and quality of groundwater and surface water for achieving sustainable water use (LAN, Art.1, Art. 9).

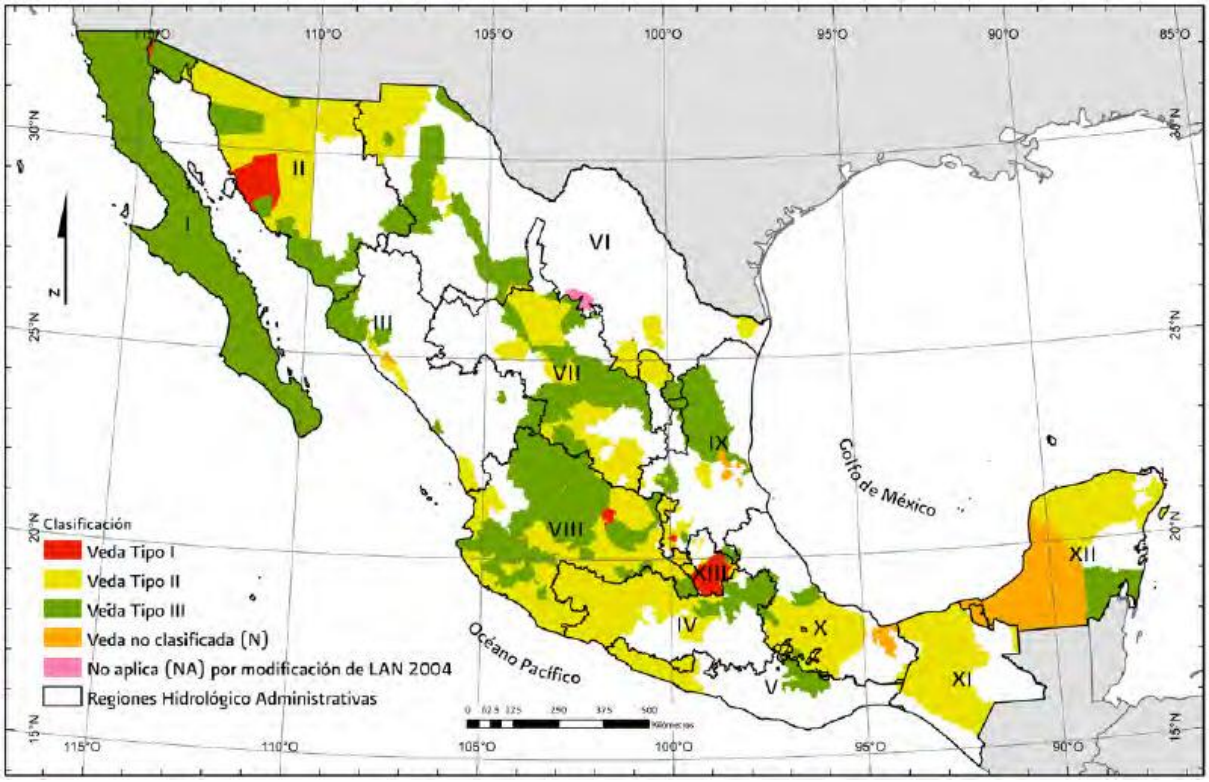
Based on the key principles of marketisation, decentralisation and sustainability, a major component of the 1992 water law reform was the introduction of a public registry of water rights (REPDA). With the reform of article 27 of the Mexican constitution in 1945, groundwater and surface water already became subject to federal regulation. Article 27, which remains valid until today, establishes that water

[3] The tracking of water governance in the Valley of Toluca began in 2006 with a MSc research (following an internship with GTZ/CONAGUA in 2004), which discovered the relative unimportance of formal regulations for groundwater governance. Field research in 2012/13 (7 weeks) and 2014 (4 weeks) investigated in detail the functioning of the illegal water rights market.

[4] Then under the Ministry of Agriculture and Water Resources.

is a property of the state. The 1947 regulations introduced prohibition zones (*zonas de veda),* as opposed to free access zones (*zonas del libre alumbramiento*), where any citizen is free to drill a well to withdraw groundwater. With the aim of countering the beginning trend of groundwater overexploitation, the state began to declare areas where the further extraction of groundwater was restricted (CONAGUA, 2012a: 86). In fact, however, the introduction of 50 such zones between 1948 and 1963 (including the Valley of Toluca) did not have any effect, since the development of groundwater resources was key to the expansion of commercial agriculture at the time, and extraction was not monitored (Wolfe, 2013: 17). In December 2011, there were 160 *zonas de veda* in Mexico (CONAGUA, 2012a: 86), covering 55% of the country's surface (CONAGUA, 2014) (see Figure 1).

Figure 1. Groundwater prohibition zones (coloured) and free access zones (white) in 2011.



Note: Veda Type I: Zones where further extraction is not possible without a dangerous demolishing or exhausting of the aquifer; type II: zones where extraction is permitted for domestic use only; type III: zones with capacity for limited extraction for domestic, industrial, irrigation, and other uses (CONAGUA, 2012a: 86-87).

With the 1992 reform – while water remains state property – the government introduced a system of private water right concessions. Concessions had partly been issued before, but they were precarious permits (Officer 1, CONAGUA Edomex, 5.2.13) issued for 50 years or even longer. Between 1995 and 2000, CONAGUA regularised water rights, i.e. water concessions were supposed to be issued for all existing water users in all prohibition zones, usually for a period of 10 years (ibid; cf. Garduño, 2005: 97 et seq.). The water title allows the user to extract a certain volume per year and is registered in the REPDA system on basin and national level. Officially, the user is obliged to submit a form to CONAGUA

stating the extraction every three months, and pay a water charge per m^3, according to the type of use.[5] A former CONAGUA officer, who used to manage regularisation during the reform of the 1990s, explains how volumes were assigned.

> In the 1990s (…) we invited everyone to regularise their wells. In 1993-94 we issued the first titles. (…) Based on the characteristics of the construction and operation of the well, I issued them the volume. Also the number of hectares played a role. For example, the *campesino* had 1 ha under irrigation. For 1 ha we used to give them 6000 m^3/year. (…) So, it was from the technical point of view. (…) There were ranches of 40 ha with wells the diameter of each of which was 8 inches. The well pumps 64 l/sec.; 24 hours per day for 7 months. So the farmer gets 1 Mm^3. There were some that had four such wells, with 1 Mm^3 per well (Retired officer from CONAGUA Central, 24.3.14).

However, according to another officer from the local office of CONAGUA, most agricultural users are "over-concessioned" and, hence, have concessions for higher volumes than they actually use. According to this informant, agricultural users could state any volume they wanted during regularisation and would get the concession. As will be clarified further below, there is great uncertainty regarding actual water extractions, in particular by farmers, because agricultural wells lack water meters and surveillance through CONAGUA. Moreover, interviewees stated that farmers do not have to pay water charges. "As farmers, we have advantages. We do not pay the water. Yes, we are treated differently than the industry and the commerce. Because we are the ones producing food" (Farmer 1, 25.1.13).

After regularisation ended in 1999 (retired officer from CONAGUA Central, 24.3.14), there was (in principle) no possibility of acquiring new concessions in overexploited aquifers anymore. In order to facilitate acquisition of water rights by new users, CONAGUA introduced a system of water rights transmissions at the end of the 1990s (Officer 1, CONAGUA Edomex, 18.01.13), which was officially implemented from 2001 onwards (CONAGUA, 2012b: 8). This means that someone who wants to extract water and does not have a concession, can only do so via a right transmission (*transmisión de derecho*) from another user who wants to cede his/her rights. A change of use type is thereby possible, and the transferred volume can be extracted from a well at another location in the aquifer, as long as it meets the technical requirements of CONAGUA. Since water is a national good and may not be sold, such water rights transmissions are free of charge, involving only an administrative fee to be paid to CONAGUA. However, in the context of high demand for water rights, a 'black market' for water rights has emerged in the Valley of Toluca and other *zonas de veda*, controlled by brokers called *coyotes*. The next section elaborates on the functioning of this 'black market' and the actors who make this market work.

THE CENTRAL ROLE OF THE 'BLACK MARKET' IN WATER RIGHTS ALLOCATION

Why is the demand for water rights increasing?

> *The industries that want to come here, at first they ask about the water. If the water is not secured, they do not come (Officer 2, CONAGUA Edomex, 19.12.12).*

Water plays a central role for the leading actors in the development of the valley. Before any new industrial plants are authorised, the investors have to show to the municipal administration that they have sufficient water rights to sustain their production. Also companies that want to expand their production are in need of water rights. While there is a certain level of illegal abstraction, which is discussed further below, the control of the private sector by CONAGUA is rather rigid. The major reason

[5] These regulations are, in fact, not enforced with agricultural water users who (in contrast to industry, services, and public water utilities) lack water meters.

is that, according to interviewees from CONAGUA as well as industrial users, the industrial sector is the one water user actually creating revenue for the state, and hence the financial basis of CONAGUA. "The industry is always the one that is most punished. They are more inspected, because they are the ones that pay most" (Officer 1, CONAGUA Edomex, 05.02.13). Volumetric charges for water used for industrial purposes are not only substantially higher than for other use types, but the sector is also the only one that in fact pays. While agricultural users are exempt by law and mostly lack water meters, most municipalities and their public water supply agencies lag years behind in their payments to CONAGUA (Officer 3, CONAGUA Edomex, 05.02.13). Private-sector users, in contrast, have to keep track of their water use in extraction reports and must not lag behind with their payments, if they do not want to get into trouble with CONAGUA.[6]

Next to companies that want to establish a plant in one of the numerous industrial parks in the Valley of Toluca, the major demand for water rights comes from the housing construction business. According to interview statements from various actors, the 'boom' of the illegal water rights market was largely due to the housing sector. After the economic crisis in 1994, the Mexican government introduced a social housing policy reform with enduring effects on the construction sector. While social housing policy and its main executor INFONAVIT had existed since 1972, the 1990s reform involved a major change in that the government agency completely withdrew from direct involvement in construction and instead exclusively focused on its role as mortgage lender for the working class (Monkkonen, 2011: 675). INFONAVIT was transformed into a bank-like agency with the aim of issuing as many loans as possible with return on investment (Pardo and Sanchez 2006 [cited in Monkkonen, 2011]).

A major part of the reform was the inclusion of private, real-estate developers (*inmobiliarias*) into the construction of low-cost housing. The outlook of secure profits based on high demand for state mortgages and a predefined number of loans issued led to a boom in the construction of low-quality housing colonies (*fraccionamientos*[7]) in the surroundings of Mexico's large cities, further fuelled by investments of the international finance business since 2000 (cf. Levin and Bain 2013).[8] With up to 10,000 identical houses constructed at once on former agricultural land, the policy changes eventually resulted in a dramatic transformation of the peri-urban landscape in Mexico. However, one of the most important legal requirements for the construction of a housing colony is the availability of sufficient water for the future inhabitants.[9] For example, for a *fraccionamiento* of 6000 houses, the developer would need a yearly volume of around 1.3 Mm^3 (coyote, 22.01.13).

Hence, new potential users demanding water for obtaining construction permits, or those wanting to expand their industrial production, are faced with a legal system that does not allow them to abstract water from the aquifer, unless they can show to CONAGUA that another user is willing to cede his/her rights. The obvious challenge is to 'find' water rights. The existence of a 'black market' for water rights is common knowledge in the Valley of Toluca, and openly talked about at CONAGUA.

[6] Several interviewees from the industrial sector stated that complying with the formalities of CONAGUA is important for them since the agency has the power to cut off their water supply.

[7] I use the term '*fraccionamiento*' since it is the term mostly used by interviewees to refer to the officially called '*conjuntos urbanos*', housing colonies that are constructed in places that do not have access to public services yet.

[8] Another important legal change facilitating the development of large-scale *fraccionamientos* on former farmland was the constitutional amendment in 1992 that allowed the selling of *ejido* land to private investors.

[9] *Fraccionamientos* have to be authorised by an inter-agential commission. Municipalities are the key actors in the authorization process, since they must approve the feasibility of the project as regards public infrastructure, including water. Once the construction of the *fraccionamiento* is finished, the concession is handed over to the responsible municipal water supply agency.

> We know that there is the practice of selling water rights, based on external arrangements: 'You give me a certain volume, I give you money, we are going to CONAGUA'. And CONAGUA does not have participation in these resources because the law states that the transmission of rights is for free. We know extra-officially that this is not correct. It is what we call the black market of water (Officer 4, CONAGUA Edomex, 28.1.13).

Most interviewees, whether from the private or public sector, talk about it as a matter of course that water rights have to be bought.

> [How do you get a water concession as a new industry?] There is a black market for water concessions. The people sell parts of their concessions. New companies have to invest money in order to obtain rights (Former president of the chamber of industry and commerce, Edomex, 20.12.12).

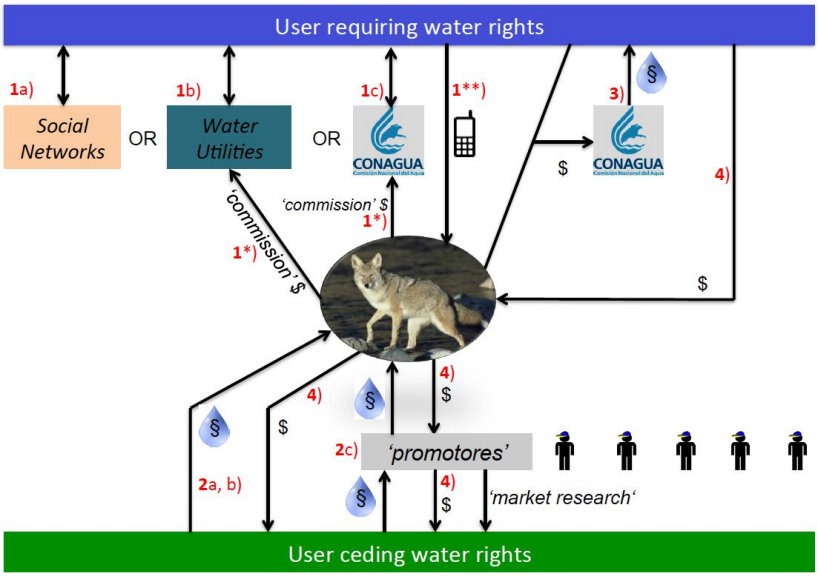
> The most difficult is the water. If [the housing colony] is not authorised, it is because they did not comply with all norms. But after a while, they go to CONAGUA and show that they have already bought the water rights (Officer, Ministry of Urban Development, Edomex, 29.1.13).

> If [our water rights] are not sufficient anymore, I can buy more. You have to invest 2 or 3 million pesos for buying the concession. It is the black market. (…) Even if I do not want to get myself into all these things, I would have to! Because of the good of the industrial park. So, you have to enter this little wheel of the future (Manager, industrial park in Toluca, 28.1.13).

Who is 'the black market', who are the actors, and how does it work?

The key actor in the transmission of water rights is the *'coyote'*. The *coyote*, whom I am referring to in this article,[10] is one of the very few actors in the Valley of Toluca[11] who has the necessary knowledge, networks, and experience to be able to function as the ultimate broker for water rights between the buyers and sellers, and in this way to create a substantial revenue. The water rights transmission involves four steps (see Figure 2):

Figure 2. Functioning of illegal water rights trading.



Note: Coyote picture taken from www.stpete.org

[10] The *coyote* prefers to speak of himself as a *gestor de agua* (water manager).

[11] According to interviewees including himself, there are around three to five such *gestores* in the Valley of Toluca.

Step 1: 'User searches for water rights'

There are three ways of getting connected with the *coyote* for an actor demanding water rights.

1 a) Via social networks: the contact to the *coyote* is transmitted via word-of-mouth within the industry and housing sectors.

1 b) Via the local water utility: The user requiring water rights approaches the municipality or respective water supply agency (organismos operadores). "We are approaching the organismos. The question is 'Who sells water rights'? – 'I will introduce you to some people [*Te presento con personas*]'" (Architect, real estate developer, 01.02.13). The service personnel at the public counters of water utilities, who has direct contact with potential clients, is an important 'gatekeeper' for the *coyote*: in exchange for a 'commission' (arrow 1*), the person establishes the contact.

1 c) Via CONAGUA: Two different staff groups at CONAGUA play a key role in the establishment of contact with the water rights broker. The first group, as with water utilities, is the staff at the public counter. The second group comprises CONAGUA's well inspectors. In the Estado de México division of CONAGUA, there are five staff members responsible for well inspections, of whom three actually go to the field. When wells are inspected, the staff often find users illegally extracting more water than their concessions allow them. Out of 180 visits they conducted in 2012, they found 140 users not complying with the regulations, i.e. the user exceeded the concessioned volume, lacked a water meter and/or proper infrastructure (Officer 3, CONAGUA Edomex, 05.02.13). A practice of 'regularisation'[12] has established itself in this context.

CONAGUA staff, instead of merely imposing a fine and eventually closing down the well, will call the coyote "…to tell me that there is a problem and that there is a well to be regularised. The inspector will tell the company that there is [the coyote] that will solve the problem. So I will acquire the necessary water rights" (coyote, 30.01.13). In this way, the *coyote* has already obtained his position as water manager for two companies. In the first case, a textile company was caught with a clandestine well that had to be 'regularised'. Since then (2008), the *coyote* has managed all water-related aspects of the company. The main task is to keep up good relations with CONAGUA to avoid further problems. In another case, it was revealed in the course of a high-level corruption affair at CONAGUA that a multinational beverage company extracted 840,000 m^3 from a well that was concessioned with 40,000 m^3. The *coyote* acquired the missing 800,000 m^3 and was hired as water manager for the company.

1 *) Both groups receive a 'commission fee' from the *coyote* for issuing the right business card.

1 **) The user requiring water rights contacts the *coyote*.

Step 2: 'Coyote acquires water rights'

There are two possible sources for the acquisition of water rights: private companies (2a) and farmers (2b).

2 a) In the first case, the *coyote* himself, in his function as water manager of a company, or hired by a company on a project basis, is the very person ceding the rights. Large companies and *inmobiliarias* (real estate developers) are often served by the *coyote* by means of a larger 'service package' or long-term contract. Depending on the clients' demands, the service can range from the mere acquisition of water rights, to a full-service package for construction projects, including the acquisition of land and water, the management of all necessary formalities with authorities including the planning and approval of streets, energy supply and infrastructure, and if necessary, 'negotiating' the rededication of

[12] It is interesting to observe that for this practice of 'making legal what was illegal', the same word ('regularisation') is used that designated the registration of wells in the early period of the reform. In this way, the 'making legal' is rhetorically normalised.

land use from agricultural into urban/residential land with the responsible municipalities. For managing all of this for a project of 3000 houses, the *coyote* needs about one year and will make 3 million pesos (ca. €165,000). Large companies with special needs in terms of water supply and sewage, such as beverage and textile industries that use and/or discharge large volumes of water, often directly employ the *coyote* as their water manager. The *coyote* takes care of all issues concerning the acquisition, sale, and management of water rights, including keeping a smooth relationship with CONAGUA.

In the context of increasing water scarcity and high water prices, many companies have implemented water-saving technologies.

> For example, in this company, six years ago, for every car we produced we used six or seven cubic metres. Now we are at the level of one and a half cubic metres. We went down from seven to one and a half (Environmental manager, US automobile company, 18.04.06).

> We have to care a lot for the water now on the industry's side. The extraction has been very strong in the last 15 years. This is why we have improved the production processes. In the last 10-15 years, we have doubled the production with a constant water volume (Former environmental manager, European company producing yeast, 17.01.13).

On the one hand, water saving is a question of surviving for the industry and, on the other, it also releases resources.

> Companies that can reduce their volume and could leave it in the aquifer in order to stabilise it prefer to sell it or transmit it to other companies before they leave it in the aquifer (Officer 5, CONAGUA, 10.05.06).

> [Is it only the farmers that sell the water?] No! Everyone, including the industry, sells the water… because it is expensive (Farmer 1, 25.01.13).

For example, the transnational beverage company, for which the *coyote* acquired 800,000 m^3, now has a surplus of water rights, because the demand for sugar-rich drinks has fallen due to increasing health-awareness, and the company had to lower its production. The *coyote* will cede the rights to two other companies of the food and pharmaceutical industry that require higher volumes. For connecting him to the clients, the lawyers managing water issues for these multinational companies will get a share of the money that the *coyote* makes in the deal (coyote, 30.01.13).[13]

2 b) In the second, most common case, the *coyote* acquires water rights from farmers. According to CONAGUA and the *coyote*, in the majority of cases, water rights are ceded from farmers. Up to 2013, the *coyote* managed 45 *transmisiones de derecho* in the Valley of Toluca.[14] The *coyote* explains the procedure.

[13] Possibly more water rights from companies will be released in the coming years. The management of the wastewater plant, which is run as a private sector initiative together by 165 companies in the Valley of Toluca, is planning to build up a distribution network of recycled water with m^3 prices of around 7-8 pesos (Manager, reciclagua wastewater plant, 17.01.13). Compared to 21 pesos that have to be paid to CONAGUA for well water, it is likely that companies will substitute recycled water for well water where drinking water quality is unnecessary.

[14] There is some uncertainty with regard to the total number of transmissions. According to CONAGUA Officer 1 (18.01.13), there were around 100 transmissions in the Valley of Toluca between 1997 and 2010: about 10-20 transmissions per year, whereas the number has been increasing, e.g. in 2010, there were 26. Out of 100 transmissions, 57 were from agricultural origin, 27 of industrial origin, and the rest from other uses (livestock breeding, services, or multiple use). However, in 2014, the same person could not verify his own statement and thought the number must be higher with around 200 transmissions. Another officer at CONAGUA stated that there were around 700 transmissions in the Edomex since 1997, with most being of agricultural origin. The uncertainty may relate to the fact that while the administrative process of a transmission must take place within 60 days, and the title transmission must be authorized within this legal time frame, the official title transmission (and inscription of the new user into the REPDA) can take years. The numbers may thus not be up to date.

> At first, I search for the water. The question is: for what do you need the water? Let's say, I buy land to construct houses for social interest – a *fraccionamiento*. So it is a project of houses for people. (…) So, for a fraccionamiento of 6,000 houses, it is calculated with 4.01 persons per house. This times 150 l/day, times 365 days a year, by 1,000 (for transforming into m^3) [he gets out his calculator and calculates] = 1,317,285 m^3. So I am going to search. There are hydrological zones. This is the aquifer of Toluca, so I have to search the water here in the aquifer. I will look who has water titles in the valley. I go to the webpage of the CNA and look who has concessioned water rights. For example, there is a man named Juan Pérez who irrigates his maize with the water. (…) I say 'cede me your rights, I need 1 million something m^3'. He says 'I want 30 pesos per m^3 as compensation'. So for 1,317,285 m^3, this would be [calculating] 39,518,550 pesos [ca. €2.2 million]. We make a contract [in which] the conditions and obligations of the intermediation are fixed. It says who is ceding the rights, and who is getting them (coyote, 22.01.13).

For farmers with large landholdings under irrigation, the creation of water rights concessions has turned wells into a gold mine.[15] In particular with the construction boom due to the government's social housing policy, demand for water rights has skyrocketed, and prices on the 'black market' have continued to rise since the introduction of rights transmissions.

> It is an important business [for the farmers]. Because it is a good business. Because the ones that need water are the *fraccionamientos* (Farmer 1, 25.01.13).

> It works based on economic principles, of supply and demand. In the Valley de Toluca they have made the water run out (se la acabaron el agua), the *habitacionales*, the *inmobiliarias*. There was a lack in offer, so the prices were rising. Here, in the Valley of Mexico, the same happened. The *inmobiliarias* terminated all the availability of water. Now, it is very difficult to find volumes of more than 100,000 m^3 (Retired officer from CONAGUA Central, 24.4.14).

In the course of the boom for land and water rights, and increasing competition on the agricultural market from the US, many farmers have sold land and water rights to *inmobiliarias*.

> Nowadays, there are only a few estates such as ours. (…) Nearby there used to be a ranch that was just sold in order to construct 8500 houses. (…) Nowadays, the offers are of the kind 'Sell me your land for constructing houses' (Farmer 2, 09.05.06).

However, it became evident during the research that in many cases the *coyote* does not buy the rights from the farmers himself. Rather, he draws on so-called '*promotores'.*

2 c) '*Promotores*' are persons who go around farmers in the Valley of Toluca and ask them whether they have water rights to sell. Due to the high prices, the financial incentives for farmers to sell land and/or water rights are high. Accordingly, the number of people who want to make money on the water rights market is also high. A farmer explains how frequently he is approached.

> There is a lot of pressure to sell the water. [How often do the *coyotes*[16] come to your house?] Very often. About three or four times per month they come to me and ask me. [People say there are many of them]. Oh yes, many. They all want to do the business (Farmer 1, 25.1.13).

According to information from CONAGUA staff and own observations, in many cases, the deals are done in teamwork. This means that the *coyote*, who is the linchpin between buyers, sellers, and

[15] It may be hypothesised that farmers possessing wells with large volumes are farmers with large landholdings. According to Sandoval, small farmers mostly lack access to water for irrigation and often live in the higher areas of the valley, where water is not even sufficient for domestic use (Sandoval Moreno, 2005; interview Sandoval Moreno 25.4.2006). Further research would be required to provide a solid picture of the type of farmers who were assigned large water volumes during regularisation, and have subsequently benefited from the illegal market.

[16] The *coyote/gestor* distinguishes himself from the *promotores*, who play a functionally different role in the system. In general parlance, however, all persons involved in water rights trading are loosely referred to as '*coyotes*', as I do in this interview.

CONAGUA, does not approach the farmers himself, but works via 'brigades' of 'second-grade' *coyotes* who take over this part of the business. While visiting a luxury car dealer with the *coyote*, who went to buy a new car, I accidentally managed to observe a short casual encounter.

> [Man around 40, driving a big car, approaching the *coyote*] Do you need rights? [*coyote*] No, I have. [Man] How many? [*coyote*] 2 million.

The *coyote* explains afterwards:

> They are 'promoters' [*promotores*]. They obtain the water rights. They are the ones going around the farmers and asking if they have rights that they want to transmit.

An officer at CONAGUA knows that the 'black market' is organised in groups.

> [The coyotes] dedicate themselves exclusively to this. They get the information about the farmers, and visit them at their house. (…) They are groups (…) Only in Toluca, there are about 50 of them (Officer 1, CONAGUA Edomex, 14.1.13).

However, in step 3 it becomes clear why not every *promotor* can become a top water rights broker.

Step 3: 'Coyote manages formal water rights transmission'

Once the 'top *coyote*' has acquired the necessary water rights, he manages the paperwork with CONAGUA.

> Then the CNA checks the validity of the rights. It asks: how is the concession of Juan Pérez? It is checking the data from the REPDA. Then, a series of documents has to be submitted to the CNA. All of this is integrated and forms a record that is presented at the CNA for authorisation of the transmission. There is a time period of 120 days in which the application has to be processed. Within this time, the CNA grants the transmission of the title. (…) Then I hand over everything to the project management at [the developer]: 'Everything is there'. I apply for permission for drilling a new well. The new well has to be located not less than 500 m away from existing wells, for not taking away water from others. They authorise the drilling of the well. Juan Perez is not allowed to extract water anymore. The CNA cancels his rights (Coyote, 22.01.13).

His knowledge and experience in legal and technical issues concerning water are key for his position as a top water rights broker in the Valley of Toluca.

> [NR: Why can the *promotor* not sell his rights directly?] [Coyote] He can also sell by himself. But the thing is that he does not know about all the legal aspects and how to do the paperwork [*trámite*] at CONAGUA. So in the end, it looks like this: the farmer J.P. sells me m^3 for 20 pesos. I sell it for 30. Of these, three are for the *promotor*, seven for me, for making the *trámite*. [How many of you are there in the Valley de Toluca, people who know well how to do the *trámites*?] There are about four to five *gestores* who know things well. [And how many *promotores*?] About 50 to 100 (Coyote, 01.02.13).

A key for becoming a top *coyote* is knowledge and experience about water rights transmissions. For a *transmisión de derecho*, a large number of legal documents and technical studies have to be submitted to CONAGUA in the correct form and time frame. For example, this includes technical studies about the new location of the well and its potential effect on other wells in the zone. Altogether, it is not uncommon that the document consists of a 5-10 cm thick folder.

> Everyone wants to do it, because there is a benefit. But you need experience. You need to know the water law and the regulation of national waters perfectly well. You need to know all the norms for carrying out the transmissions, and managing the transmissions. For the projects, you have to know how to configure the project, how to integrate all the elements that are required, such as water, street, energy, infrastructure, everything. It is experience. You also need experience in the contracting of technicians (Coyote, 22.1.13).

The *coyote,* who has a degree in law as well as in engineering, has gained his experience through 57 transmissions (45 of them in the Valley of Toluca) that he facilitated in the last 10-12 years.

> Many of them are lawyers. Or they are people who used to work here [at CONAGUA]. (…) [What type of people are the *coyotes*?] Most importantly, they have experience in the topic, and know people. They know people at CONAGUA (Officer 1, CONAGUA Edomex, 14.1.13).

An important aspect of knowing people at CONAGUA, and having experience in water rights transmissions, is the social capital necessary to 'deal' with higher-level bureaucrats having the power to authorise the transmissions. According to an anonymous interviewee involved in water rights transmissions, corruption payments to higher-level CONAGUA officers are necessary in order to get legal authorisation. The *coyote* explains that "the most important is to have good relations with people at CONAGUA, and know who you can trust there. It is based on reciprocity. Because you give your life in the hands of the other" (Coyote, 22.1.13).

In order to establish the contact to clients, it is not only key to have good relationships with staff at CONAGUA and the municipal water suppliers. Over time, the *coyote* has gained a name among the private sector, to the extent that he was employed as water manager for several companies. A good reputation is important, since there have been problems with fake water titles on the 'black market', as these quotes suggest.

> There are also falsifications of titles. They negotiate with fake titles, with copies. So when the new user comes here, he finds out that the original title does not exist anymore. But they have already paid the money (Officer 1, CONAGUA Edomex, 14.01.13).

> More than the [m^3] price, it is the trust that is important. The trust that the documents are not false (Coyote, 22.1.13).

The successful management of the business to the satisfaction of the client over time creates trust and a reputation on the market, which safeguard the *coyote'*s position as top water broker.

Step 4: 'Compensation payments'

When the *transmisión de derecho* is officially authorised through CONAGUA, all 'compensation payments' are made. Over the years, the water rights transmissions have turned into a market with substantial turnover and financial benefits for all actors involved.

> They have tons of money. In the past, the m^3 cost 5 pesos. This was about 20 years ago. Now, the price is up to 30 pesos per m^3. So for 20,000 m^3, the coyote will get 600,000 pesos [ca. €33,000]. You can become a millionaire in a very short time. They are all millionaires. They drive *camionetas* [pick-ups] that cost 1 million pesos. (…) Water is now more expensive than gasoline (Officer 1, CONAGUA Edomex, 14.1.13).

According to the same officer the price for one m^3 was about 5 pesos in 1997. Various sources have consistently stated that in the Valley of Toluca, prices in 2013/2014 were around 28-35 pesos (ca. €1.60-2) for the buyer (ibid; coyote 22.01.13; farmer 1, 25.01.13; architect, real estate developer, 01.02.13). In the four aquifers of the Valley of Mexico, prices range between 15 and 23 pesos, and in the aquifer of Ixtlahuaca-Atlacomulco the m^3 values around 13 pesos (farmer 3, 07.03.13; coyote, 14.04.14; retired officer from CONAGUA Central, 24.3.14). How much the seller gets apparently depends on the number of intermediaries necessary for making the deal, and also on the volume that is sold (ibid). Rights transmissions usually involve several hundred thousand to 1-1.5 million m^3, and thus create a considerable source of income for rights brokers, those selling rights and other involved actors. The price increase and regional differences are likely to reflect the increasing and differing demands for water rights in the context of real estate developers' activities. One of the reasons why the price

composition is difficult to track, however, is the unknown rate of 'authorisation payments' to CONAGUA officers.

THE WATER RIGHTS MARKET – AN INSTRUMENT FOR COUNTERING OVEREXTRACTION?

The water reform, which assigned individual users water rights that (in *zonas de veda*) may be transferred via rights transmissions, has – under conditions of high demand for water – led to the emergence of an illegal market for water rights. The primary sellers of water rights are (to the best of my knowledge, large-scale) farmers, who were assigned high volumes during the process of regularisation in the 1990s. The primary buyers are real estate developers, and private (domestic and international) enterprises. In the private sector, it is not uncommon that water rights are demanded after illegal water extractions have been discovered by CONAGUA's well inspectors. In recent years, the industry also became a seller of water rights due to water saving technologies as well as production decreases in the case of a beverage company.

What we are seeing in Mexico is an 'accidentally' created but de-facto existing water rights market. This provides interesting insights concerning debates on water rights markets as instruments for implementing environmental policy objectives. The question is to which extent water extraction is monitored by the state authority in order to make surplus water rights detectable in the first place. The question is crucial because without monitoring it is impossible to cancel surplus rights for counteracting overexploitation. The LAN actually foresees a mechanism for the 'collection' of surplus rights, namely the concept of expiration of water rights (*caducidad*). It involves the cancellation of rights for water volumes that the user does not use for 2 years in a row (Ley de Aguas Nacionales, Art. 29-3). However, the system of *caducidad* so far has not led to the reduction of water extraction.

Firstly, the private industry has successfully lobbied against *caducidad*. The following statements show how water rights – also as a consequence of their commercialisation on the 'black market' – are perceived as private property by the industry, and their cancellation is seen as improper interference of the state into private matters.

> Every time we are recycling water we are reducing our extraction. Up to the risk that the CNA takes away the extraction rights from us because we are saving. This is our conflict with this authority. Instead of a reward to the industries that save a lot of water and reduce extracting it from the well, there comes a punishment called '*caducidad'.* They are taking away the right for what he does not extract. Even if it has cost money to buy the rights for extraction from someone, the CNA, without remuneration for what he has paid, can take away the extraction rights (Environmental manager, US automobile company, 18.04.06).

> It is a social conflict. The property rights have to be respected. It cannot legally be the case that you own something, and then a group comes and wants to decide over your property (coyote, 22.01.13).

Apparently, by bringing forward the discourse of water rights as private property, the industry usually wins the case against CONAGUA backed by lawyers.

> When [CONAGUA] applies the *caducidad*, it is normally with the industry. But they defend themselves. (…) 'I leave the water for future growth'. They win the case with the help of lawyers (Officer 3, CONAGUA, 05.02.13).

In this context, the government introduced guarantee quotas (*cuotas de garantía*) with the new regulation in 2010. Since then, users may pay a fee of 14 pesos for every m^3 they do not use, and in this way evade the *caducidad*. Therefore, out of 14 proceedings in the Valley of Toluca in 2012, handling about 1 million m^3 of surplus water rights, none were cancelled because the companies' lawyers managed to negotiate for paying a guarantee quota (ibid). In the end, "the system of *caducidad* only affects a minimum of users. It only becomes effective when they are not extending their titles on time [i.e. when formal mistakes are committed]" (Officer 1, CONAGUA Edomex, 14.01.13) and "It is a

measure that does not help much" (Officer 4, CONAGUA Edomex, 28.01.13). This means that surplus water rights are made available for commercialisation on the 'black market', instead of restoring the aquifer (or being allocated to public use). The fact that water users are not supportive of the *caducidad* system due to business interests is the major reason why attempts to implement participatory groundwater management in the Valley of Toluca by means of establishing a groundwater user committee (COTAS) were doomed to failure.[17]

Secondly, a key material feature of groundwater is its invisibility (Wester et al., 2011). The question is thus whether at all surplus water rights become 'visible' so they could be potentially reduced. This is clearly often not the case, because a large part of water extraction in the Valley of Toluca is not metered and/or thorough surveillance of water extraction is deficient. In fact, a substantial share of water extraction is not even under the formal control of the local direction of CONAGUA, as the Federal District (*Distrito Federal*, or D.F.) diverts massive volumes out of the aquifer of Toluca for the supply of the metropolitan zone of Mexico City (*'Lerma system')*. According to Müller (2008: 71), the Lerma system produces around 5 m^3/s for transfer to Mexico City. This would amount to 158 million m^3, i.e. 37% of the official extraction in the Valley of Toluca. However, there is uncertainty with regard to the data on water extraction.[18] Additional research would be necessary in order to provide a quantitative estimation of how many wells have fitted meters, and it is a matter of speculation how many illegal wells there are.[19] However, there is reasonable evidence to suggest that actual extraction from registered wells is hardly monitored. Farmers' wells in most cases lack water meters and are not subject to surveillance through CONAGUA. Further, as this statement illustrates, wells are not sealed when the concession is transferred.

> With the agriculture, it happens that they sell 90% of their volume, so they remain with only 10% of what they used to have. But they think, ah, I do not have a water meter, and they still extract the same volume that they used to. [NR: What happens then?] When we find out about this, they are sanctioned, the well is closed. But out of 1000, it happens to one that they close his well. It *should* be done (Officer 1, CONAGUA Edomex, 14.01.13).

According to urban water utilities, their wells have meters. However, since public urban use is a political priority, the titles of public water utilities are formally not concession titles, but so-called 'assigned titles', implying that they cannot be cancelled or transferred.[20] For industrial wells, undergoing the strictest control by CONAGUA, it can be assumed that they commonly have meters. However, as mentioned above, there are only three CONAGUA staff inspecting wells. It is likely that in many cases, companies extract more water than they are entitled to. "[The textile company] extracts 200,000 m^3, but the concession is only for 80,000. This is no problem, because if all the documents are in order and

[17] Between 2001 and 2008, the GTZ (former German Agency for Technical Cooperation) (unsuccessfully) assisted CONAGUA in the establishment of a groundwater user committee (*Comité Técnico de Aguas Subterraneas* - COTAS) in the Valley of Toluca.

[18] Müller (2008) does not provide the source for this figure. Various sources (CONAGUA 2006; GTZ 2008; Ortiz et al., 2013) state that 84-89% of water extracted from the Valley of Toluca aquifer is for domestic use, whereas a large share is allotted to water exports to the D.F. Calderhead et al. (2012, based on IMTA 2003) state that domestic use within the Valley of Toluca accounts for 52%, and exports to Mexico City for 38%. However, calculations based on primary data from REPDA obtained via CONAGUA show a different picture, with domestic use in the Valley of Toluca accounting for only 27% and exports to the D.F. for 16%; by contrast, agriculture use accounts for 26%, industrial use for 18%, and the remaining for multiple use (8%) and service (5%). The large discrepancies in available data, and the fact that monitoring is lacking, imply that there are high uncertainties with regard to actual water use patterns.

[19] CONAGUA estimates that around 90% of the actually existing wells in the valley of Toluca are regularised (Officer 1, CONAGUA Edomex, 05.02.13). However, due to lack of monitoring, it is difficult to verify such statements.

[20] Letting aside that there are most likely no surplus water volumes due to steadily increasing population and very high water leakage rates.

you pay on time, you keep your things in order, it is very unlikely that the CNA will come and check your extraction" (Coyote, 30.01.13).

In summary, monitoring of groundwater extraction is not sufficient to facilitate the cancelling of surplus rights for ecological restoration. Moreover, a supposedly large share of water extracted from the aquifer of Toluca is transferred to the D.F. for domestic supply. It is thus questionable whether a reduction of water extraction in Toluca would have major effects at all.

Since there are high uncertainties as regards actual water extraction, it is also difficult to say if the existing water rights market is a mechanism for allocating water towards economically 'more efficient' uses (Rosegrant and Binswanger, 1994). In the case presented here, there is a transfer of water rights from agricultural to urban and industrial uses, but due to lack of surveillance, the question is to what extent there is also a transfer of *water*, i.e. whether farmers' selling of water rights leads to a redistribution of water extraction from agriculture to the private and housing sectors. On the one hand, housing colonies are mostly constructed on former agricultural land, and urban areas have expanded enormously in the last two decades. It can thus be assumed that the farming activity, i.e. actual irrigation, is reduced with the selling of water rights. In the Valley of Toluca, a large share of transfers goes towards public water utilities.

Finally, there is little reason to believe that the current water governance structure, based on the existing regulation and illegal market transfers, leads to the reduction of extracted volumes. On the contrary, it is likely that total groundwater extraction is still increasing, as suggested by the continuing decline of groundwater tables.

WATER SCARCITY AND INCREASING REGULARISATION UNDER PEÑA NIETO

Mexico is currently undergoing a process of further regularisation of groundwater extraction. On 5 April 2013, the government released eight general agreements, suspending the free access to groundwater in those parts of the country where water extraction had not been regulated yet (DOF, 2013) – the white areas in Figure 1. The agreements imply that wells are being regularised in the whole country (cf. CONAGUA, 2014). Also in zones where concessions were issued already in the 1990s, a further push for regularisation of groundwater extraction can be observed. In 2004, 2008 and 2014, there were decrees that offered regularisation to those who extract water based on expired titles, even in *zonas de veda* (DOF, 2014). According to interviewees in Texcoco[21] and DF, as well as newspaper reports, there is generally a stronger push for the monitoring of wells since 2013, including those of municipal water suppliers and farmers. How can this push towards increasing regularisation and monitoring be interpreted?

In an official communiqué, the 2013 suspension of free access zones is legitimised by the scarcity of, and conflicts over, water, and the need to provide legal certainty over water rights to water users.

> In the last decade, organised groups of agricultural producers with large economic and technical capacity have expanded in the dry states of North Mexico, where they acquired large areas of land and constructed hundreds of wells in a short time, in order to extract important volumes of groundwater, most likely more than the poor natural recharge of aquifers, provoking the disagreement of the concessionaries in the adjacent *zonas de veda*, and even resulting in violent encounters between user groups. (…) The suspension of free access and the subsequent regulations constitute a great step in the management of hydrological resources, in providing CONAGUA the technical, administrative and legal elements for facilitating the administration of the rich hydrological heritage conserved in the underground. (…) The control of extractions through regulations will give the users legal certainty over their concessioned water volumes,

[21] Texcoco is a municipality in the Estado de México, located west of Mexico City.

> and above all, it will secure them and their successors a permanent water supply, providing sustainability for their developments (CONAGUA, 2014, translation by the author).

However, apart from this 'rational planning' explanation, another reading is suggested by the analysis of water rights transmissions above. The following statement by a former senior head-office CONAGUA official, now active as a private water consultant, suggests that the illegal market has consolidated itself as a structure possessing its own dynamics and emerging properties.

> Last year (…), the Peña Nieto government released a decree: it established *zona de veda* in the whole country. So the market will continue in the same way. [NR: In the whole country? But the *zona de veda* status depends on the availability of water, doesn't it?] There are new studies of availability. It is not allowed to drill wells anymore. [But is the information on these studies correct?] Not even the public register is correct. It is for putting numbers. There are very strong economic interests behind it. And political interests as well. It is a lot of money (*muchísimo dinero*). Including that, people of the state and federal governments have concessions of millions of m^3. I know of someone who had 4 million m^3. It is a lot. Two of these were sold to [name of housing company]. I would like to know how he got them… Later, in the CNA… The director. His brother also did not have concessions before, later he did. [Is there really water scarcity?] In zones, yes. In Torreon, Chihuahua, in the North of the country. There is a lot of scarcity. [And in the centre?] Here [in the D.F.]… Yes there is. Because if not, the government of the D.F. did not have the necessity of bringing it here. [What about the Valley of Toluca?] There it is another situation. The water is… Yes, there is availability. Just that they have restricted it with the *veda*. I think that yes, there is [water]. First of all, in the Valley of Toluca. All these… more serious studies, I think that yes, there is availability. But it is a very complex formula to measure availability. [It seems that it is not so important whether there is or there isn't water.] This is the key point! The issue is of a cultural, political, and economic kind. Water bears all these situations.

This account can be interpreted as suggesting that the extension of groundwater prohibition zones is a strategic attempt for securing economic interests associated with illegal water rights trading rather than a rational planning exercise for ecological sustainability. The actual policy formulation process as well as the situation in other parts of Mexico would have to be investigated in detail in order to show that the regularisation of groundwater extraction throughout the country is a strategic move. Nevertheless, based on the above analysis of the existing water rights allocation regime in *zonas de veda* of Central Mexico, it is clear that water scarcity is key to the reproduction of the illegal market system. However, it is the discursive production of scarcity, and hence, *legal* scarcity rather than physical scarcity that is relevant to 'black market' actors. In this respect, it is at least questionable whether the protection of the "rich hydrological heritage" is the only motivation in the suspension of free access to groundwater. While the creation of an illegal water rights market was an unintended consequence of the policy reform of the 1990s, it now has powerful interests associated with it.

CONCLUSION

The present paper has shown that policy reforms introducing individual water rights concessions in Mexico have resulted in the emergence of an illegal water rights market. The illegal water rights regime emerged in the context of a neo-liberal social housing policy that was implemented without considering how the massive newly-built colonies would get access to water. Real estate developers, in charge of the construction of the colonies, thus created an enormous demand for water rights. Those possessing water rights were suddenly in a position of owning an increasingly scarce good, and a business case for *coyotes* was born.

With substantial financial turnover, the illegal market has become a defining characteristic of the water rights allocation regime in the Valley of Toluca, and as interviews suggest, in other zones of semiarid Central Mexico. Extending the legally constructed water scarcity across Mexico through regularisation of water extraction in previously 'free drilling zones' (*zonas del libre alumbramiento*) may

possibly extend these illegal market structures. The findings could have strong implications for the understanding of the broader political economy of groundwater in Mexico. Additional research is needed in order to assess the scope of illegal market structures and their implications for groundwater governance in other parts of Mexico. Nevertheless, some observations can be made based on the Toluca case.

The analysis shows that the establishment of a system of individual water rights concessions does not automatically lead to a reversal in the trend of groundwater overexploitation. Several factors explain that groundwater governance in the Valley of Toluca is ecologically not sustainable.

First, the water rights regime has not led to a decrease of extraction rates, which are currently exceeding natural recharge. For individual water rights to function for ecological sustainability, secondary regulations would be necessary that work towards the absorption of surplus rights for the restoration of the aquifer. The ecological sustainability aims of the 1990s water reform are currently not met due to interests on the part of state officials as well as of water users. Regarding the state, the research suggests that CONAGUA officials are among those benefitting from illegal water rights trading. The illegal water rights market is not restricted to informal actors operating outside of the state, but the state is involved in this market. There is thus a vested interest within the state administration to authorise the transmission of water rights instead of cancelling surplus rights for counteracting overexploitation. [22]

Enforcing legislation that reduces groundwater extraction, such as the *caducidad* system, is also opposed to the interest of water users with surplus water rights. Up to now, these users have managed to defend their interest and keep these surplus rights. Users requiring new water rights, i.e. the housing-construction sector and industry, have so far accommodated themselves to the existing mechanisms due to a lack of alternative ways of acquiring these. This adds to the findings of Wester et al. (2009a, 2011) on the establishment of groundwater user committees (COTAS) in Mexico, suggesting that it may not only be a lack of institutional support that precludes user committees in (semi)arid Mexico from becoming 'drivers for change' as regards reductions in groundwater extractions.

Second, the water right allocation regime is currently not in favour of ecological sustainability since water rights are not strictly coupled to de facto extraction: it can be assumed that due to a lack of monitoring, some users extract substantial volumes without possessing the rights to do so. This means that water rights are sold while actual extraction is not necessarily reduced, that granted volumes are exceeded but 'trouble' is prevented by being on good terms with CONAGUA, and that there may still be illegal wells.[23]

What are the future prospects of water governance in Mexico, considering the findings presented in this paper? The current push for regularisation and surveillance suggests that there is an effort to strengthen the coupling of water rights with actual extraction. This could be considered as a necessary step for managing groundwater extraction. However, the fact that there is now a market for water rights in which government officials have a vested interest, may prevent the allocation of water based on criteria of ecological sustainability and priority for public use – as emphasised in formal government policy. The establishment of 'good water governance', in the sense of a rigorous enforcement of the 1992 water right reform, under the present conditions would result in a more tightly organised (illegal)

[22] Moreover, there is a process of 'producing more legal water' in that CONAGUA still regularises wells in long-established prohibition zones such as Toluca. This increases the volumes available for the 'black market'. This means that apart from the possible geographical extension of illegal water rights markets to new areas, there is also an expansion of the titles available for illegal trade in a given area. It should be noted that the legalisation of illegal excess use, such as in the case of the beverage company, does *not* 'produce more legal water', because legalisation happens through buying an existing right.

[23] See footnote 18.

water market in which money power determines different actors' access to water. In other words, water would effectively be privatised, even if it is legally the common property of Mexican citizens.

Considering the important consequences for social and ecological sustainability of water use in Mexico, the observed phenomena deserve attention from scholars and policy makers. Further in-depth investigation, also in other parts of Mexico, is needed in order to follow up these highly dynamic recent developments.

REFERENCES

Adler Lomnitz, L. 1988. Informal exchange networks in formal systems: A theoretical model. *American Anthropologist* 90(1): 42-55. www.colbud.hu/honesty-trust/lomnitz/pub01.pdf (accessed in February 2014)

Calderhead, A.I.; Martel, R.; Garfias, J.; Rivera, A. and Therrien, R. 2012. Pumping dry: An increasing groundwater budget deficit induced by urbanization, industrialization, and climate change in an over-exploited volcanic aquifer. *Environmental Earth Sciences* 66(7): 1753-1767.

CONAGUA (Comisión Nacional del Agua). 2010. Financing water resources management in Mexico. www.conagua.gob.mx/english07/publications/OECD.pdf (accessed in December 2013)

CONAGUA 2012a. Atlas del Agua en México 2012. www.conagua.gob.mx/CONAGUA07/Noticias/SGP-36-12.pdf (accessed in December 2013)

CONAGUA 2012b. Bancos del Agua en México. www.conagua.gob.mx/bancosdelagua/sgaa-4-12-bam-12.pdf (accessed in May 2014)

CONAGUA 2014. Suspensión provisional del libre alumbramiento. www.conagua.gob.mx/Contenido.aspx?n1=3&n2=62&n3=379 (accessed in May 2014)

DOF (Diario Oficial de la Federación 2014). 07/04/2014, Decreto por el que se otorgan facilidades administrativas a los usuarios de aguas nacionales. www.dof.gob.mx/nota_detalle.php?codigo=5339590&fecha=07/04/2014 (accessed in May 2014)

DOF (Diario Oficial de la Federación). 2013a. 05/04/2013. Acuerdo general por el que se suspende provisionalmente el libre alumbramiento de las aguas nacionales del subsuelo en el acuífero que se indica, and subsequent agreements. www.dof.gob.mx/index.php?year=2013&month=04&day=05 (accessed in April 2014)

DOF (Diario Oficial de la Federación). 2013b. 20/12/2013. Acuerdo por el que se actualiza la disponibilidad media anual de agua subterránea de los 653 acuíferos de los Estados Unidos Mexicanos. Obtained from CONAGUA Dirección Local, Estado de México.

Edomex (Gobierno del Estado de México). 2012. *Zona metropolitana del valle de Toluca. Aspectos sociodemográficos.* Toluca: Gobierno del Estado de México.

Garduño, H. 2005. Lessons from implementing water rights in Mexico. In Bruns, B.R.; Ringler, C. and Meinzen-Dick, R. (Eds), *Water rights reform: Lessons for institutional design,* pp. 85-112. Washington, DC: International Food Policy Research Institute.

Klett, B. 2006. Wasserbilanz des Wassereinzugsgebiets Valle de Toluca. Bad Homburg: GTZ. (unpublished).

Levin, J. and Bain, B. 2013. Mexico housing hits U.S. investors as plan collapses. *Bloomberg Market Magazine*, Dec. 6, 2013. www.bloomberg.com/news/2013-12-06/mexico-housing-hits-u-s-investors-as-plan-collapses.html (accessed in January 2014)

Molle, F.; Wester, P. and Hirsch, P 2010. River basin closure: Processes, implications and responses. *Agricultural Water Management* 97(4): 569-577.

Monkkonen, P. 2011. The housing transition in Mexico: Expanding access to housing finance. *Urban Affairs Review* 47(5): 672-695.

Morton, A.D. 2003. Structural change and neoliberalism in Mexico: 'Passive revolution' in the global political economy. *Third World Quarterly* 24(4): 631-653.

Müller, R.B. 2008. Wasserkonflikte im zentralmexikanischen Hochland; Analyse und Hintergründe der Konflikte um die Wasserverteilung zwischen Mexiko-Stadt und dem Umland. Doctoral Dissertation, Universität Bremen. http://d-nb.info/990354415/34 (accessed in September 2014)

Pardo, M. and Velazco Sanchez, E. (Eds). 2006. El proceso de modernización el INFONAVIT 2001-2006. Estrategía, redes y liderazgo. Mexico City: El Colegio de México. Cited in Monkkonen (2011).

Perret, S. 2006. New paradigms, policies and governance in the water sector. In Perret, S.; Farolfi, S. and Hassan, R. (Eds), *Water governance for sustainable development. Approaches and lessons from developing and transitional countries,* pp. xxi-2*.* London: Earthscan.

Rap, E. 2006. The success of a policy model: Irrigation management transfer in Mexico. *Journal of Development Studies* 42(8): 1301-1324.

Rap, E. and Wester, P. 2013. The practices and politics of making policy: Irrigation management transfer in Mexico. *Water Alternatives* 6(3): 506-531.

Rosegrant, M.W. and Binswanger, H.P. 1994. Markets in tradable water rights: Potential for efficiency gains in developing country water resource allocation. *World Development* 22(11): 1613-1625.

Sandoval Moreno, A. 2005. *Acceso, usos y control del agua por mujeres y hombres en la cuenca hidrológica del acuífero del Valle de Toluca.* Toluca: GTZ.

Secretaria de Desarollo Urbano (Estado de México) 2011. Comentarios al libro denominado 'Zonas metropolitanas, 200 años de realidades mexiquenses'. Presentation by J. Aguilera Ortega. Toluca: Unpublished.

Turton, A.R. 1999. Water scarcity and social adaptive capacity: Towards an understanding of the social dynamics of water demand management in developing countries. MEWREW Occasional Paper No. 9, Water Issues Study Group, School of Oriental and African Studies (SOAS), March 1999. https://www.soas.ac.uk/water/publications/papers/file38353.pdf (accessed in February 2014)

Wester, P. 2008. Shedding the waters: institutional change and water control in the Lerma-Chapala Basin, Mexico. PhD thesis, Wageningen University. https://www.researchgate.net/profile/Philippus_Wester/publication/40099417_Shedding_the_waters__institutional_change_and_water_control_in_the_Lerma-Chapala_Basin_Mexico/file/5046352973328a8a27.pdf (accessed in May 2014)

Wester, P. 2009. Capturing the waters: The hydraulic mission in the Lerma-Chapala Basin, Mexico (1876-1976). *Water History* 1(1): 9-29.

Wester, P.; Hoogesteger, J. and Vincent, L. 2009a. Local IWRM organizations for groundwater regulation: The experiences of the Aquifer Management Councils (COTAS) in Guanajuato, Mexico. *Natural Resources Forum* 33(1): 29-38.

Wester, P.; Rap, E. and Vargas-Velázquez, S. 2009b. The hydraulic mission and the Mexican hydrocracy: Regulating and reforming the flows of water and power. *Water Alternatives* 2(3): 395-415.

Wester, P.; Sandoval-Minero, R. and Hoogesteger, J. 2011. Assessment of the development of aquifer management councils (COTAS) for sustainable groundwater management in Guanajuato, Mexico. *Hydrogeology Journal* 19(4): 889-899.

Wilder, M. 2010. Water governance in Mexico: Political and economic apertures and a shifting state-citizen relationship. *Ecology and Society* 15(2): 22.

Wolfe, M. 2013. The historical dynamics of Mexico's groundwater crisis in La Laguna: Knowledge, resources, and profit, 1930s-1960s. *Mexican Studies/Estudios Mexicanos* 29(1): 3-35.