Minqin used to be a green oasis located at the border of the Gobi desert. Over the past decades the region suffered from falling water tables and dying vegetation. From 2007 the Chinese government has embarked on a large project to "save the oasis" and drastically reduce the agricultural use of groundwater in the area. Unlike cases in other parts of the world, the reduction of groundwater pumping through direct regulation measures here seems to have been successful. We try to explore the dynamics behind the implementation of regulation policies and understand why the formation of Water Users' Associations (WUAs) was such an essential step in the implementation process.

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HIGHLIGHT

How WUAs Facilitate Direct Groundwater Regulation

A Case Study of Minqin County, China

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HOW WUAS FACILITATE DIRECT GROUNDWATER REGULATION

A CASE STUDY OF MINQIN COUNTY, CHINA[1]

Research highlight based on Aarnoudse et al. (2012)[2]

INTRODUCTION

Like in South Asia, extensive groundwater use by a large number of smallholders has led to serious groundwater depletion in China (Qiu 2010). Different observations exist in regard to the response to this development. For some, groundwater management appears "unregulated" (Wang et al. 2007) and "disconnected from the official water bureaucracy" (Giordano 2009). Others describe cases of collective groundwater management by farm groups (Bluemling et al. 2010). Moreover, in comparison with India, there seems to be a stronger "presence of water administration at grass roots" (Shah 2003), which suggests that direct groundwater regulation measures (which act within the water sector) can be implemented more easily. In this paper we present a case study from North West China, Minqin County in Gansu Province, to show that institutional structures in rural China can indeed be favorable for direct groundwater regulation.

Over the last decade the Chinese government became actively engaged in groundwater management and has sought to influence the behavior of groundwater users. Whereas the national policies on groundwater management are still rather weak, the national government is increasingly promoting groundwater regulation measures to be adopted at local levels (Sun et al. 2009). In the case study area, groundwater regulation measures were implemented in 2007 as part of a water policy reform at river basin level. In parallel, the local government promoted the formation of WUAs in charge of groundwater irrigation. We argue that, in this context, the formation of WUAs did not in the first place lead to participatory solutions. It above all strengthened the relationship between county level water authorities and existing groundwater institutions at farm group level, thereby enabling the implementation of groundwater regulation measures.

The argument is derived from empirical research conducted in Minqin County between May and July 2010. During a first orientation, different districts of Minqin were visited and about 15 farmers were interviewed informally. Thereafter semi-structured interviews were conducted with government officials of the Water Resources Bureau of Minqin (WRBM) and the Agricultural Bureau of Minqin. One township in the lower reaches of Minqin's delta was selected for an in-depth survey. In the township, three diversely located villages were surveyed. In each village the village leader and one or two farm group leaders were interviewed. They were asked questions about the general situation of their village or farm group, and changes in terms of groundwater use and agricultural practices since the 1980s. Furthermore, per village 10 to 15 farmers were interviewed, using semi-structured questionnaires. They were asked questions about the specific situation of their household and changes in terms of groundwater use and agricultural practices since the 1980s. In the following Highlight we briefly present our research results. See Aarnoudse et al. (2012) for a more detailed description of the research methods and a discussion of the findings.

MINQIN'S GROUNDWATER HISTORY

Minqin County is located in the delta of the landlocked Shiyang River, which is emerging on the Tibetan Plateau and ending in the Gobi desert. The delta stretches out over more than 100 km and declines from 1500 to 1300 m above sea level. Low rainfall levels, between 100 to 200 mm per year, make irrigation indispensable for Minqin's agricultural development. In the 1960s, the construction of a dam upstream and a canal irrigation system was finalized; however, water supply through the irrigation system was not reliable. Since the 1970s the rural population, organized in farm communes and production teams, started to pump from the easily accessible

[1]This IWMI-Tata Highlight is not externally peer-reviewed and the views expressed are of the authors alone and not of IWMI or its funding partners.

[2]This paper is available on request from p.reghu@cgiar.org

groundwater. In less than ten years five to ten wells were dug and drilled per production team (amounting to about 10000 wells). Tube wells were originally 50 to 70 m deep and dug wells were up to 20 m deep. With those new wells much barren land was brought into cultivation.

In the 1980s, most operating wells originated from the well drilling hype in the 1970s. Yet, many ill-constructed wells were abandoned and some wells were replaced by tube wells. Even though de-collectivization and China's market liberalization were taking place, the former production teams, so-called farm groups, continued to collectively invest in drilling wells. Particularly in the lower reaches, farmers were facing falling water tables and saline groundwater. Pooling capital enabled the farmers to make new investments to reach the falling groundwater table and search for less saline groundwater. Unlike in the 1970s, the new investments only allowed for little expansion of the irrigated area in the surveyed villages.

In the 1990s only a few new wells were drilled, all of which are considered deep wells (>100m). In the three surveyed villages a total of five new collective wells were drilled. The wells usually replaced non-functional wells and were drilled deeper with the assumption that deeper water would be of better quality. Some deep wells were privately drilled, which means that the investment was made by a single household. Drilling of private wells was only possible outside the collectively irrigated land. Due to land constraints, very few private wells were drilled. Out of the three surveyed villages only one had a private well drilled in the 1990s. This shows that the groundwater economy hardly privatized and collective investments by farm groups continued to play the most important role.

Since the late 1990s no new wells have been drilled in the three surveyed villages. This coincided with a movement of out-migration from Minqin's lower reaches. About 15 percent to 30 percent of the population left during the 1990s. Some farm groups were even completely abandoned. The people who stayed behind are mainly elderly. The ageing population partly explains why there has been little investment in drilling new wells since the late 1990s.

Not only the investments in drilling wells, but also the distribution of water across users was organized by farm groups. Since the 1980s, the irrigation time had been decided during meetings held between the household heads of a farm group. Each family used to be responsible for preparing the earthen canals and irrigating their own plot. One family member was sent to the land when the previous irrigator notified his/ her turn was almost over. Whether to join or skip an irrigation turn and the amount of water per plot depended on each irrigator's personal decision.

In the early 1980s, the electricity grid was expanded to the most remote agricultural areas and all villages switched from diesel to electricity for groundwater pumping. In most farm groups the electricity use was registered per family to calculate the costs. Farmers would register the meter reading after their irrigation turn. In theory this meant that those who used more water, also used more electricity, and would thus pay higher costs. However, in practice the electricity costs were considered low and the respective differences in costs were minor so that they did not constrain water use.

During the 1970s, wheat was the main crop in Minqin. During the 1980s this changed, especially in the lower reaches. Here, the farmers started to grow less wheat and more fennel and melon for the production of melon seeds. Many farmers described how the wheat simply withered and died under the saline conditions. From the beginning of the 1990s cotton was also introduced as a new crop. In early 2000, when the cotton price increased, cotton was taken up on a large scale by the farmers. Although cotton requires large amounts of water, it is relatively salt tolerant and provides a high income per unit of water.

The crop changes which took place cannot be singled out as a result of increasing groundwater depletion. Agricultural policies and market prices also played an important role in farmers' decision making. In fact, Minqin's farmers continued growing high water demanding crops, despite declining water tables and signs of desertification. Only salinization can be identified as a water-related factor which influenced the cropping pattern.

Water policy reform in 2007

In 2007 a water policy reform drafted in the Shiyang River Basin Management Plan was approved. The objective of the Shiyang River Basin Management Plan is to halve agricultural groundwater use in Minqin by 2020. The WRBM is the executive authority who has to implement the policy reform. At its establishment in 1956 the WRBM's main activities were restricted to surface water management. Through the new management plan, they were explicitly assigned groundwater management tasks.

Whereas the policy reform includes different aspects, we focus here on the implementation of direct regulation measures. Two main regulation measures were effectively implemented: (1) the closure of wells and (2) a per capita water use restriction. According to official records, a total of 3000 wells were closed from 2007 to 2010, which left

4000 operating wells in Minqin. To compensate for the closure of wells, a sum of USD 768 to 4915 (2007), depending on the year of construction, was offered to the well-owning farm group. In total 16 wells were closed in the three surveyed villages. From zero to two wells were closed per farm group.

Moreover, the WRBM gradually restricted water use by a so-called "water quota", i.e. a per capita standard volume of irrigation water with which theoretically 0.193 ha of land could be irrigated. The water quota differs per irrigation district depending on the soil and climatic characteristics as well as suitable crops under these conditions. In the lower reaches the water quota is set at 415 m³ per 0.077 ha per year (equivalent to 620 mm). According to the WRBM this is sufficient to grow cotton or melon, but too little to grow maize or wheat. The water quota is supposed to be controlled through the use of smart card readers at pumping installations. With those readers installed, farmers can only turn on the pump by swiping their smart card. When there is no more water left on their account the pump turns off automatically.

The role of WUAs

As part of the water policy reform, WUAs were created throughout Minqin. The government officials explained that WUAs are created to fulfill new national policies which require engaging water users in water management. However, we have identified WUAs as an important entity created by the county government to implement the closure of wells and the per capita water use restriction. WUAs strengthened the relation of the government with water users and thus provided a means of control.

All villages were instructed by the WRBM to form a WUA. Since 2007, each village in Minqin has a WUA and each household officially became a WUA member. The WUA is represented by a WUA board, which includes a president, treasurer, secretary, two elected representatives and the farm group leaders. The WUA board is most of the time identical to the existing village committees, plus farm group leaders. However, to carry out the new WUA tasks, the board holds separate meetings. Moreover, the president, secretary and treasurer receive an extra salary from the WRBM on top of their village committee salary. New tasks and responsibilities of the WUA board are mainly related to groundwater management.

Selecting wells which were to be closed (2007-2009)

Once the WRBM had decided the number of wells which had to be closed per village, the WUA selected the respective wells. WUAs hence could decide depending on the local conditions. Applied criteria were rather similar for the three surveyed villages. First, farm groups with the highest well density were selected by the WUA. Farm groups then chose wells which had a low water quality or were surrounded by land with poor soil quality (too sandy or too salty). According to the policy procedure, these wells were filled up with cement and the electricity supply was cut off.

Issuing water permits per household

The WUAs have the responsibility to issue water permits per household and calculate each household's water rights according to the water quota. On the permit a household's irrigated land area and allocated water use is registered. The water permit is renewed annually to account for changes in the number of household members. Although it is hard to check whether the numbers on the permits agree with actual water use, different sources confirm that the per capita irrigated land decreased significantly. According to official records, a reduction of about 40 percent of irrigated agricultural land was realized from 2007 to 2010 in Minqin. The interviewed village leaders estimate that about 38.5 to 69 ha were abandoned in their villages due to the closure of wells (about 15 percent to 35 percent of original cultivated area). Based on the household questionnaires farmers lost about 0.231 ha per household (about 20 percent of original cultivated area).

Supervising the farm group's "water account"

To control farmers' per capita water use, smart card readers were supposed to be installed on each pumping set. In fact, only in some cases the smart card system was functioning well. In those cases, the farm group received one smart card per well to turn on the pump. Each smart card is attached to a "water account" administered by the Irrigation District Bureau (IDB). The farm group leader (member of the WUA board) is in charge of the smart card and is authorized to upload the card at the IDB. Since the irrigation turn is still carried out as before - with one farmer after another irrigating their plots without time restrictions - it happens occasionally that there is not enough water on the "water account" to irrigate all plots belonging to the command area of the well. In practice, the farm group leader can go to the IDB to request a little extra water and reload the card. After all, the amount of water per irrigation turn is not severely reduced. Water saving is mainly expressed in longer intervals between irrigation turns and consequently fewer groundwater irrigation turns.

Despite a few exemplary cases, smart card machines were either not installed or not functioning well at the majority of wells in the three surveyed villages. In one village the system with smart card readers was functioning well, although only for 13 out of 26 wells. In another village, card readers were installed on 12 out of 59 wells, but 9 of them were broken shortly after installation and were never used. In the most remote village, not a single smart card reader was installed, or planned to be installed. Through the survey it was not possible to identify the reason for this divergence.

However, even in the village without smart card readers, farm groups lost their decision making power over the frequency of groundwater irrigation turns. Here the IDB had locked the pump houses and kept the key. The farmers could only irrigate when the district bureau allowed them to pick up the keys. The timing and number of groundwater irrigation turns was thus controlled by the IDB. This was a completely new situation compared to the management of irrigation turns by farm groups before 2007.

Conclusion

Unlike conclusions drawn from earlier studies (Giordano 2009; Mukherji and Shah 2005; Steenbergen 2006), our research shows that self-management by water users or indirect measures (through the energy sector or agricultural policies) are not the only existing measures to regulate groundwater use in small scale agriculture. In the case at hand, direct groundwater regulation is implemented in an environment where groundwater use is organized through collective institutions which are amendable to state control. The implementation of measures for the restriction of groundwater use was facilitated by the formation of WUAs, which linked the pre-existing collective groundwater institutions to the local water bureaucracy. By assigning regulatory tasks to the WUAs, the function of the pre-existing groundwater institutions was transformed from managing "water exploitation" to managing "water conservation".

It should, however, be borne in mind that the reform policy enters in a context of out-migration and a reduced interest of local farmers to invest in agriculture and make a living in the delta's lower reaches. Moreover, three years after policy implementation, little can be said about the long-term impact on the economic and environmental sustainability of groundwater use. The closure of wells resulted in a significant reduction in crop production, which is likely to threaten the economic viability of local agriculture. On the other hand, reduced crop production may be an inevitable trade-off to bring groundwater depletion to a halt (Konikow and Kendy 2005).

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The IWMI-Tata Water Policy Program (ITP) was launched in 2000 as a co-equal partnership between the International Water Management Institute (IWMI), Colombo and Sir Ratan Tata Trust (SRTT), Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations. Through this program, IWMI collaborates with a range of partners across India to identify, analyze and document relevant water-management approaches and current practices. These practices are assessed and synthesized for maximum policy impact in the series on Water Policy Highlights and IWMI-Tata Comments.

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