Water Policy 21 (2019) 1081–1095

Whose water? Whose profits? The role of informal water markets in groundwater depletion in peri-urban Hyderabad

Sumit Vij[a], Anshika John[b] and Anamika Barua[c]

[a]*Corresponding author. Public Administration and Policy, Wageningen University & Research, 2041, Holladseweg 1, 6706 KN, Wageningen, Gelderland, The Netherlands. E-mail: sumit.vij@wur.nl*

[b]*Independent Researcher, Hyderabad, India*

[c]*IIT Guwahati, India*

Abstract

Urbanising cities of India are engulfing the peri-urban land and water resources. Informal water sellers, who transfer water from peri-urban to urban areas, meet the growing water demand in Hyderabad, one of the fastest growing cities in India. This article qualitatively explores how informal water tankers are changing the flows of water, posing challenges to water access for peri-urban residents. We conclude that apart from the state's infrastructural and capacity challenges to provide piped water, power interplay between actors is responsible for the mushrooming of informal water markets. The transfer of water has contributed to groundwater depletion as well as to the water insecurity of peri-urban residents.

Keywords: Groundwater; Hyderabad (India); Informal water market; Peri-urban; Power interplay; Water tankers

Informal water markets in peri-urban spaces

With the neo-liberal reforms (1991) in India, there was a paradigm shift from a state-run country to a nation that is built and managed by private investors (Pedersen, 2000; Roy, 2009). These reforms reduced the role of the government in sectors such as agriculture, education, health, and industries and, at the same time, liberalised import–export policies and rules for foreign investments, allowing privatisation of capital (Shah, 2010). Since these reforms, the rate of urbanisation has increased in Indian

doi: 10.2166/wp.2019.129

cities, sustained by a real-estate boom and a growth of information technology (IT) outsourcing and other service sectors (Mehta & Karpouzoglou, 2015; Friedmann, 2016; Shatkin, 2016; Tian *et al.*, 2017). With urban agglomeration and increasing pressure of population, there is an increase in water demand in cities, aggregating pressure on groundwater and surface water bodies in peri-urban areas (Vij & Narain, 2016; Vij *et al.*, 2018). Peri-urban areas are defined as dynamic spaces where rural and urban activities, processes, and institutions co-exist (Tacoli, 2002; Shaw, 2005; Forman & Wu, 2016; Allen *et al.*, 2017).

State policies that seek resources for urban expansion support the appropriation of land and water from peri-urban areas. For instance, state authorities acquire peri-urban commons (grazing land, traditional rainwater harvesting structures) for urban infrastructures, such as water and sewage treatment plants and for special economic zones (Levien, 2012; Narain & Singh, 2017). In the bargain, state authorities use expensive technologies to dig into aquifers and extract groundwater for maintenance and operation (Ruet *et al.*, 2007; Ranjan, 2012). This results in city infrastructure engulfing peri-urban spaces for building drinking and wastewater canals[1], sewerage and water treatment plants, dumping yards, entertainment parks, and new residential gated communities (Sharma-Wallace, 2016).

As public infrastructure and utility services in India are unable to meet the growing city needs for domestic and industrial water (Saleth & Dinar, 1997; McKenzie & Ray, 2009), this water supply and demand gap are met by drawing ground water from peri-urban villages by informal water suppliers. This has led to the growth of informal water markets that facilitate transfer of groundwater, both in terms of space (peri-urban to urban) and by sector (agriculture to recreation/industries) (Rosegrant & Binswanger, 1994; Tacoli, 1998; McGregor & Simon, 2012), contributing to groundwater depletion and water insecurity in peri-urban areas.

Among several kinds of informal water supply, the most common are the private tankers (Solo, 1999; Bakker *et al.*, 2008; McKenzie & Ray, 2009). These tankers provide water services to a large share of the world's poorest urban residents (Kjellén & McGranahan, 2006; Shaban & Sharma, 2007; Venkatachalam, 2008). In India, they transport both raw and treated water from peri-urban villages to the cities for household consumption, industrial use, and for real-estate construction (Janakarajan, 2009; Mundoli *et al.*, 2015; Narain & Vij, 2016). These tankers operate as an alternative arrangement with unique service modalities for consumers (Ahlers *et al.*, 2014), resulting in a robust, informal system running parallel to the formal water supply network. Prakash *et al.* (2015) and Londhe *et al.* (2004) conclude that informal water tanker markets attempt to meet 'the water demand-supply gap' in metropolitan cities of India.

Critical water scholars have identified and characterised the informal water tankers as 'water mafias' or 'water thieves' who have the ability to use their power and break the boundaries between formal and informal water markets (Graham *et al.*, 2013; Ranganathan, 2014). Studies have also criticised the informal water markets for their aggressive pricing, unreliable water quality, peri-urban groundwater extraction, and use of agricultural water for urban purposes – highlighting conflicts and concerns of

[1] Since 2000 various canals are constructed to meet the growing demand of the Gurugram (Gurgaon) city. There are three canals, the Gurugram-Jhajjar Canal, the NCR (National Capital Region) Canal and the GWS (Gurugram Water Supply) Channel. The first of these canals carries the waste of the city through the peri-urban villages while the latter two were built to carry fresh water from the countryside to water treatment plants to provide water to the city. Canals supply water to the water treatment plants and further take water to the city for domestic and industrial purposes.

inequity and injustice for peri-urban residents (Hinkfuss, 2010; Mehta *et al.*, 2014; Zwarteveen & Boelens, 2014).

In India, actors such as local politicians, the peri-urban elite, and water sellers in peri-urban areas have been able to create an informal water market. The nexus between such actors is leading to over-exploitation of peri-urban resources and marginalisation of peri-urban communities for their own profits (Arabindoo, 2009). In this article, we define nexus as a linkage between formal (actors representing government organisations and institutions) and informal (actors such as water sellers and private tanker owners) water actors, where the interplay between actors (re)shape water access and control (Dunbar, 2004). Powerful actors with more bargaining resources are able to control and access water for making profits and to use water to sell in urban centres. Relatively less powerful actors such as peri-urban residents are losing access and control over the water resources due to weak bargaining resources. However, the connection between actors and power interplay in peri-urban areas remains insufficiently understood (Prakash, 2014).

Against this background, we select peri-urban Hyderabad (India) as our case to answer two specific questions: (Q1) *How do informal water tankers operate and extract ground water in peri-urban Hyderabad?* and (Q2) *What kind of power interplay exists between actors involved in water selling?* The two questions dwell upon the understanding of how certain actors marginalise other actors relating to issues of water access and gains over water by using their bargaining resources, such as finances, social status and political connections (Ahmed & Zwarteveen, 2012). Authority, position in society and political networks give power to the actors to control, access and use water for their profit (Sultana, 2018). This approach of power interplay helps to explain why some actors benefit from informal water market while others lose. For example, a higher caste or economically well-off household may use their social status and economic strengths to bargain better access to water as compared to a lower caste or economically weak household. The socio-economic status may also help to gain political power that can improve access to water.

The article draws insights from a research project 'Ensuring Water Security in Metropolitan Hyderabad', initiated in 2015 by SaciWATERs[2] to understand informal water markets in peri-urban villages of Hyderabad City. Qualitative methods such as semi-structured interviews and focus group discussions (FGD) were used to collect empirical data, explaining the water flow and power interplay between the actors involved in the operation of informal water tankers.

The article is divided into three sections. The first section elaborates the conceptual approach, context and the methodology of the study. The second focuses on key findings of this research and discusses how tanker water flows and power interplay take place. The last section highlights key insights of the study: changing groundwater usage in peri-urban villages and marginalising peri-urban residents. In addition, it looks at how the nexus between local politicians, peri-urban elite and water tanker sellers is becoming strong and decisively moving towards individual profit-making.

Context: urban and peri-urban Hyderabad

Hyderabad is located in a semi-arid agro-climatic zone (see Figure 1) and is experiencing increased climate variability in the form of increasing temperature, sporadic rainfall and decreasing soil moisture

[2] SaciWATERs, the South Asia Consortium for Interdisciplinary Water Resources Studies, is a policy research institute located in Hyderabad, India.

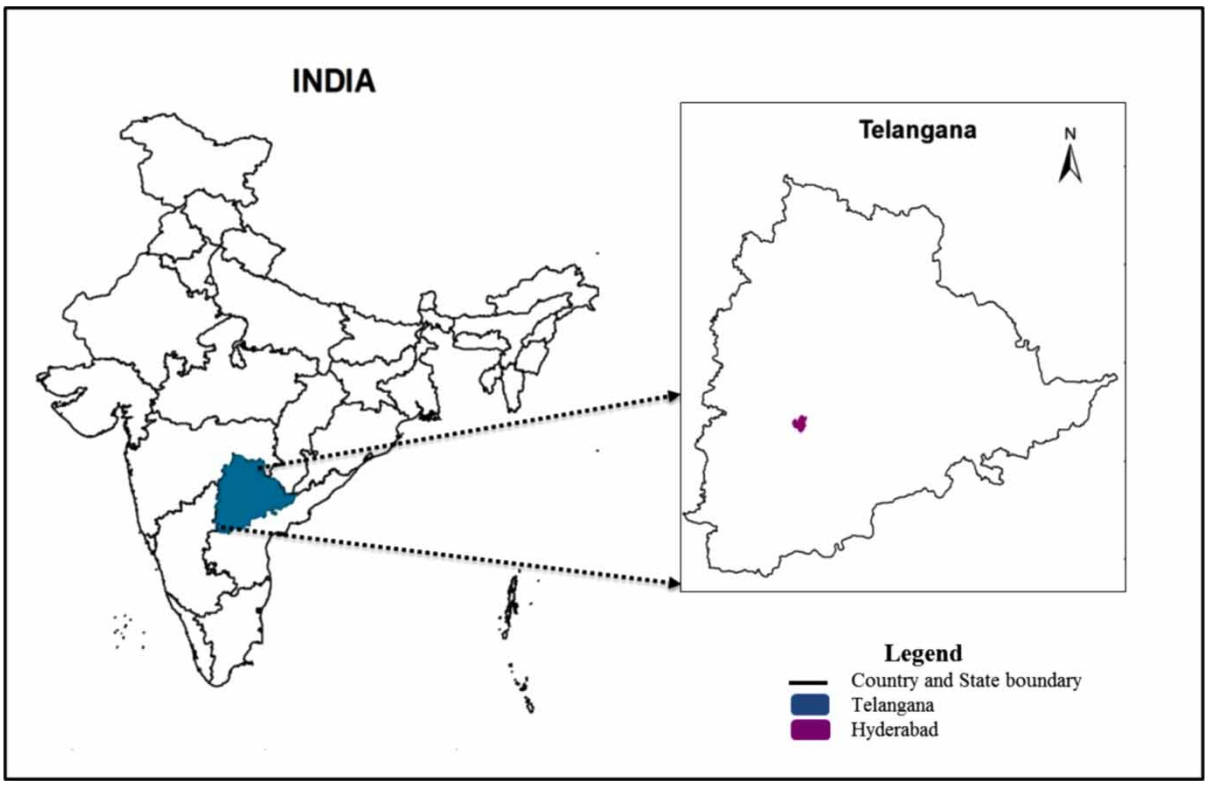

Fig. 1. Map of India, Telangana and Hyderabad city. *Source*: prepared by Indian Institute of Technology Guwahati, India.

(Van Rooijen *et al*., 2005; Vasu *et al*., 2016). Shorter rainy seasons of higher intensity and less frequency of rainfall have increased people's reliance on groundwater. The annual potential evapotranspiration is much greater than precipitation in Hyderabad, and groundwater recharge depends primarily on high-intensity storms and the storage of excess rainfall in surface depressions (de Vries & Simmers, 2002). Dourte *et al*. (2012) suggest that increases in rainfall intensities may be one of the many factors contributing to the regional groundwater depletion in Hyderabad. Further, the catchment areas of the city (mostly peri-urban) are under water stress due to rapid urbanisation and climate variability (Ramachandraiah & Prasad, 2004; Agilan & Umamahesh, 2015). Franco *et al*.'s (2015) study suggests that water bodies coverage in Hyderabad city has reduced by 67%. Lakes and tanks have been the main source of water, but erratic rainfall, land acquisition and encroachment have made the residents depend completely dependent on water supply and groundwater. A study by SaciWATERs reported that between 2004 and 2012, 13 lakes/tanks had disappeared within the Mir Alam Basin[3]. This inter-linkage between climate variability and urbanisation is more acutely felt in the transitional, peri-urban spaces than in the urban core (Padgham *et al*., 2015; Vij & Narain, 2016).

[3] Hyderabad city is located in the Mir Alam Basin, with 21 small lakes. The basin used to have a main lake covering an area of 840 acres (340 hectares). In 2016 it was reported that the structure had shrunk to 400 acres (162 hectares).

Hyderabad is the capital city of the state of Telangana and *hoc-tempore* capital of the state of Andhra Pradesh in South-India. The city has undergone development post-liberalisation, with a rapid growth of new residential areas, the IT industry, and educational and research centres (Ramachandraiah & Prasad, 2008). Indian economic liberalisation brought changes in the way decision-making happens, by allowing the federal government to share powers with the state (Krueger, 2002). With these new forms of economic power, states are trying to transform cities into engines of growth, using global IT demand and favourable economic and institutional reforms.

Along with climate variability, changes in political regimes and the liberalisation process have reshaped the water supply services in Hyderabad (Bunnell & Das, 2010). In the late 1990s, the Telugu Desam Party[4] (TDP) government was the first state government to negotiate an independent loan from the World Bank to implement economic and governance reforms in the basic (agriculture, irrigation, health and education) and service sectors (information and technology, tourism and real-estate). The loan was agreed with conditions for economic reforms, but mainly was available for urban growth and service sectors, thereby neglecting the externalities created by unsustainable and rapid urbanisation (Bandyopadhyay, 2001; Celio *et al.* 2010).

Urban development and water policies, particularly regarding drinking water and irrigation, were discussed in a 'Vision 2020' document prepared by the World Bank. The document emphasised the need for water pricing and privatisation of the water sector (Bandyopadhyay, 2001). The vision document represents the dream of a technology-driven state government working to improve basic sectors, but the actual thrust turned out to be only on fast-growing service sectors. Mooij's (2007) study suggests that basic sectors did not benefit from institutional reforms and financial support.

During the same time period, the TDP government formulated the Water, Land and Trees Act (WALTA) of 2002[5] and the Neeru Meeru programme[6] to conserve groundwater in Telangana, but these policy instruments also had a little on-the-ground impact to protect groundwater resources (Manor, 2004). Hyderabad's urban expansion continued with the launch of the Jawaharlal Nehru National Urban Renewal Mission[7] in 2005, a joint central-state sponsored scheme. The scheme emphasised the need for the development of peri-urban areas and urban corridors while justifying and facilitating state-led appropriation of land and water resources in peri-urban areas (Das, 2015).

Urban and peri-urban Hyderabad areas have been facing and will continue to face water insecurity – especially with respect to drinking water, sanitation and agriculture (Prakash, 2014). Media and government reports suggest that the groundwater table of Hyderabad city is below the danger mark[8] and is continuously depleting (Deccan Chronicle, 2015; Times of India, 2019).

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[4] A regional political party active in the South-Indian states of Andhra Pradesh and Telangana.

[5] A comprehensive law enacted by the government of Andhra Pradesh to promote water conservation and tree cover and regulate the use of ground and surface water.

[6] A programme launched by the state government for the conservation of water by the creation of awareness and community participation.

[7] The Jawaharlal Nehru National Urban Renewal Mission is a city-modernisation scheme launched by the Government of India.

[8] The average fall in the groundwater table across Hyderabad District ranged from 0.14 m to 3.79 m below ground level (BGL). The groundwater level has crossed the danger mark of 10 m BGL in Marredpally, SR Nagar, Darushifa, Nampally, Asifnagar and Chandrayangutta (localities in Hyderabad).

Methodology

The study used a qualitative research design (Yin, 2015) and follows analytical generalisation (Halkier, 2011). Three villages in peri-urban Hyderabad were selected to collect details on informal water flows (Figure 2) – Kokapet (K), Adibatla (A) and Malkaram (Mk). The study villages lie along a so-called Outer Ring Road (ORR), which is an eight-lane expressway encircling the city. The population of the three villages is 3,200, 3,038 and 2,800 persons, respectively (Indian Census, 2011).

The selection of the three villages was based on a rapid rural appraisal (RRA) in 20 peri-urban villages. The RRA was conducted as part of the scoping study for the research project mentioned above. During the RRA general issues of water quantity, quality and selling were discussed, amongst others in FGD with men and women. Various water sources were mapped to understand the flow of water inside and outside the villages. Criteria for the selection of the villages were proximity to Hyderabad, peri-urban characteristics such as the flow of goods and services between the city and the villages, existence of water selling and buying markets, and groundwater quality and quantity issues. Five villages were selected for the research project, three of which are part of this article's analysis. Kokapet and Adibatla are surrounded by various industries, set up after 2000. These industries required water and found their source in the groundwater of these two villages. Malkaram is part of a larger village Jawaharnagar (see Figure 2) and is surrounded by a dump yard.

Semi-structured interviews were conducted between April and December 2016 by one of the co-authors. Table 1 shows the classification of respondents. Only one-time respondents were included (77) and not those who had participated more than once. Interviews and group discussions were conducted in Telugu and later translated into English by two team members, who were fluent in both

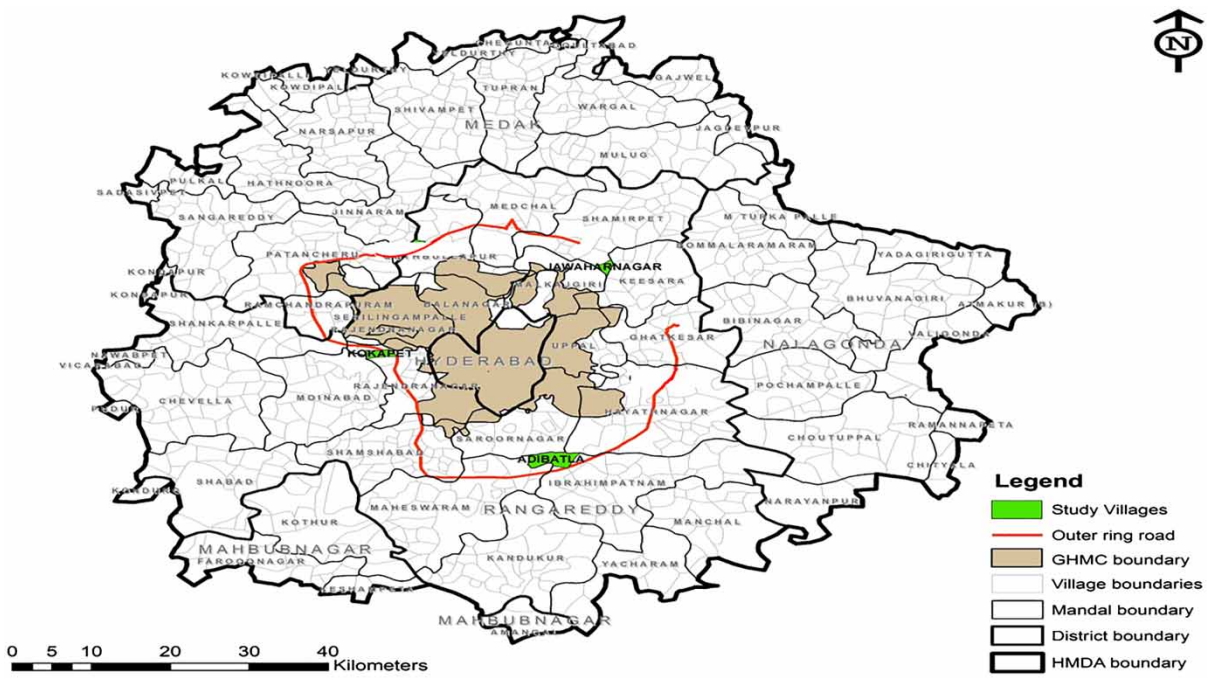

Fig. 2. Map of study villages. *Source*: prepared by SaciWATERs, India.

Table 1. Type and number of respondents per type of session.

Type of people	Key person interview	Group discussion
Peri-urban residents	16	4
Migrants from other cities/states	3	4
Women's groups	–	4
Bore well owners/ tanker drivers/watchmen	25	3
Panchayat[a] members	4	1
Farmers (small and marginal)	4	2
Leasers of bore well to Panchayat	3	1
RO plant owners/caretakers	17	–
Teachers/Anganwadi workers	3	–
Ramky Group[b] employees	2	1
Total	77	20

[a]Solid waste management company near Malkaram.
[b]A Panchayat is a village council; the first level of local government in the Indian administration.

languages. Interviews were meant to capture narratives concerning informal water flows from peri-urban villages to the city. Questions were mostly pertaining to the flow of water and the way in which power interplay between actors influences the control and access over water resources. Respondents were selected using a snowball method and in consultation with key informants, covering diverse opinions around the growth of informal water tankers.

All interviews and discussions were recorded and transcribed. Interview respondents reflected on the day-to-day operation of water procurement and supply in and out of the three study villages. FGDs were conducted to triangulate the information from the interviews, especially around the power interplay of actors. The group size varied from three to 13 persons.

In addition to these techniques, several newspaper articles (published till August 2016) discussing issues of groundwater pollution, land acquisition and other conflicts in the study villages were collected and analysed for a better understanding of the social, political, and ecological background of these villages.

To maintain the confidentiality of the respondents, the article uses categories such as (F: Farmer, L: Local resident, T: Tanker operator, P: Panchayat member), along with a village code (Adibatla: A, Kokapet: K, Malkaram: Mk). Same-type respondents from the same village are distinguished by numbering (L1A, L2Mk …).

Findings

Findings section is divided into three sub-sections. The first section deals with the question on how informal water tankers operate and extract ground water in peri-urban villages, the second section elaborates on the shift of peri-urban residents from being farmers to water sellers and the third section discusses the power interplay between actors involved in water selling.

Changing flows of water: groundwater extraction and selling

'*There is a panchayat-owned bore well in which we used to get water at 400 feet in the beginning of 2014. But this year (2016), we had to drill to 800 feet to get water.*' (P1 K)

Groundwater in peri-urban areas has been used majorly for three purposes: irrigation, household chores and drinking. Most respondents confirmed that the level of groundwater has been falling continuously in the last ten years. For peri-urban residents, urbanisation is a process that they can see unfolding in terms of expanding city limits, converting rural agriculture land into residential or industrial zones, and increasing demand for water from surrounding villages (Gomes & Hermans, 2018; Shrestha *et al.*, 2018). Respondents mentioned that the flow of water from their village to Hyderabad city has increased manifold in the last two decades, which has put additional pressure on groundwater. Respondents also mentioned that water sellers transport groundwater out of the village to support other users, when the villagers are indoors. People are calling it 'water theft' (Graham *et al.*, 2013; Narain & Singh, 2017).

During resource mapping, a respondent showed how their water resources for irrigation had changed due to decreased and irregular rainfall. Traditionally in Telangana, lakes/tanks have been the main source of irrigation for agriculture, but erratic rainfall, land acquisition and encroachment have made farmers completely dependent on groundwater. This change in the source of irrigation water has had an immediate effect on small and marginal[9] farmers and their agriculture, as groundwater extraction is unaffordable and highly uncertain in terms of availability. Moreover, the dependence of peri-urban residents on groundwater for domestic purposes has also increased manifold for lack of other options and they have to also depend on the private tankers for drinking water and for other household purposes. Panchayat is responsible for providing water for domestic purposes. However, as groundwater levels have depleted, this has forced Panchayat to ration the supply of water from a few days per week to a few hours. In addition, the outflows of water from the villages through water tankers have further worsened the situation. Respondents confirmed that during summer, an average of 30 tankers carry about 5,500 litres/tanker of water that are sold to urban pockets outside the villages for domestic, commercial and industrial uses. Water operators of *Kokapet* village have been selling large amounts of water to various multinational companies in Hitech City, an ultra-modern urban centre in Hyderabad city, created particularly to attract IT and other service sector companies. For recreational purposes, the establishment of an amusement park has created a demand for groundwater from *Adibatla* village, and the water is supplied to the park through tankers.

There is a difference in the pricing of water that is sold within and outside the village. During summer in March–June, water was sold for Rs.400–500 (~$75, including transportation cost and profit) inside the village and outside for Rs.750–800 (~$110, including transportation cost and profit). Therefore, not surprisingly, most operators indicated a preference for selling their water outside their respective villages for higher profits.

Groundwater in the peri-urban study villages has not just depleted in terms of quantity but also quality. Malkaram, due to its proximity to Hyderabad's largest dump yard, has faced a sharp decline in the quality of its groundwater, which has become polluted by toxic leachate. Respondents mentioned that they face acute water crises during the summer months (March–June), and due to lack of alternative sources of water, poor peri-urban residents and small landowners use this (contaminated) groundwater not just for household purposes, but also for drinking and agriculture. Residents from Malkaram also confirmed that there are incidences of water contamination-related diseases and depletion of agriculture soil fertility due to contaminated water. Until a decade ago, the villagers used to drink untreated groundwater. But now residents have started buying treated water because of the deteriorating quality. A

[9] Traditional rainwater harvesting structures constructed for water storage, especially to be used during summer.

considerable portion of groundwater is treated in reverse osmosis plants, which are owned by private actors in the village and sold as drinking water to households (at Rs.10–15 for 20 litres). All of these are transforming groundwater from a public good to a private good. The consequences of such a transformation are worst for those who are rapidly being excluded from the circle of benefits, i.e. small and marginal[10], peri-urban farmers and poor peri-urban residents.

The following sub-sections discuss some of these actors and how do they operate the informal water business.

Farmers shifting to water selling

> '*Last year, a few others and I bought water from tankers sometimes, to irrigate our fields. Everybody's bore wells are dry. Some poor farmers could not even afford tankers. Lack of irrigation facilities are pushing farmers to other jobs, such as construction labour, water selling and car driving in the nearby city.*' (F3A)

Respondents reported that farmers are abandoning farming and moving towards selling water. Factors such as land acquisition for urban infrastructure, sporadic rainfall and droughts and lack of market access for agriculture produce have been responsible for farmers to consider water selling as an alternative occupation.

The construction of the Outer Ring Road in the early 2000s resulted in a significant loss of agricultural land. This is clearly visible in Kokapet and Adibatla. Farmers were compensated with two to three plots of land sized 23.4 square metres elsewhere in the village, in proportion to the size of their previous landholding. Farmers mentioned that these plots were scattered, hence too small for intensive farming. The farmers also related groundwater depletion to lack of rainfall and recent droughts between 2013 and 2015 (Hindu, 2015; Hindustan Times, 2016). Some farmers dug a bore well and started selling water. By selling one plot (land per square yard is INR 5000–6000 ~ 100 USD), farmers were able to arrange money to install a bore well and a storage tank on their remaining plots. As water selling became more viable on these scattered plots, the farmers shifted their occupation to water selling. Interestingly, then, groundwater depletion may be seen as both a cause and a consequence of the informal water market. Some farmers are also starting to work as daily-wage labourers or low-salaried workers in factories and industries, in nearby cities.

Currently, there are only three people in Kokapet who are still farming, but they are struggling due to lack of irrigation facilities. When asked about how they were sustaining, F1 K elaborated: 'There are no rains and the produce is less. Farming is a tough job, it requires us to be in the field all day and I cannot afford to pay another labourer to work. We have no transport to go sell our produce in the city. Vegetable vendors come in an auto, buy our produce and sell it in the city while paying us very little'.

[10] 'Large Farmer' holds the land above 5 hectares. 'Small Farmer' means a farmer cultivating (as owner or tenant or share cropper) agricultural land of more than 1 hectare and up to 2 hectares (5 acres). 'Marginal Farmer' means a farmer cultivating (as owner or tenant or share cropper) agricultural land up to 1 hectare (2.5 acres). The definitions have been retrieved from a Debt Relief Scheme of 2008 and adopted by the Reserve Bank of India, Ministry of Finance, India, and the Department of Land Reforms, India. Please see the following link: https://rbidocs.rbi.org.in/rdocs/Notification/PDFs/84634.pdf.

Respondent in both Adibatla and Kokapet village mentioned that the transfer of water for different uses have made the situation worse which had several implications on their livelihood. With water increasingly being used for urban consumption, there is less and less access to and availability of it for agricultural usage. The gains in urban uses are more private and profit-oriented, especially in the informal water market. This form of water market makes water a tradable commodity, and there is no equitable way to share water. As a result, marginalised, peri-urban farmers are forced to buy that same water for agriculture or change their occupation to other urban-centric employment. Such water flows, from peri-urban to urban areas, provide water security to city dwellers, but this is at the cost of making peri-urban residents water insecure[11].

Moreover, such incidences indicate that the peri-urban farmers are failing to negotiate their control and access to water during the power interplay between actors involved in the informal water market. Although they are aware of water scarcity and different ways the water is moving from their peri-urban communities to the city, they are unable to challenge the powerful actors to maintain their access and control over groundwater.

Power and profits: water markets in peri-urban villages

> '*Adibatla is supposed to get Krishna*[12] *water. Even the Tata Company gets water from there. The Panchayat keeps telling us that the water will come soon. But it hasn't come till today. When they installed the pipelines, there was water in it for two-three weeks. But again, the pipes broke. After that, we never got Krishna water*.' (L5A)

Adibatla has a special economic zone[13] (SEZ) for which the state government has provided the water supply. According to a government order passed in 2004, if a water pipeline for the city or industries passes through a village, the village is entitled to that water. Adibatla, as an en-route village, therefore received water from the River Krishna in 2004 for a few weeks. In the last 3 years, two repairs have been made in the broken pipeline, but the village has not been receiving water. Again, in January 2017, the pipeline broke; it is yet to be repaired (May 2018). Interestingly, a water operator (a local government employee) said that the pipeline had never been broken, it had only been clogged with stones and debris. To meet the water supply, the Panchayat has been buying water during the summer from a prominent water seller, who happens to be a Mandal Parishad Territorial Constituency (MPTC) member, an institutional body above Panchayat in local governance hierarchy. Respondents corroborated that the Panchayat is reluctant to get the pipeline fixed – as the MPTC member earns huge profits from water selling to the village.

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[11] Public–Private partnership is a cooperative arrangement between two or more public and private bodies, typically of a long-term nature. In this case it is used as a model to purify water and provide it to the villagers, while the surplus is to be sold in the open market.

[12] The Krishna River is the fourth largest river in terms of water in-flow and river basin size in India. The river is almost 1,300 kilometres long. The river is also called Krishnaveni. It is a major source of irrigation for the states of Telangana, Maharashtra and Andhra Pradesh.

[13] SEZs are specific areas designated by the government to increase investment and development and provided with economic advantages – for example lower taxes (compared to elsewhere in the country).

We found that the involvement of local government officials in the informal water markets is intrinsic to its operation. Respondents confirmed that the Panchayat and the MPTC member have entered into an informal arrangement to create artificial scarcity of Krishna water in the village. The nexus between local politicians is ensuring the continuity of water tanker sales in the village. In return, as the MPTC member holds a higher position in the hierarchy of local governance, the Panchayat members could ask for political favours by agreeing to this informal water market arrangement. Such localised nexus of actors does not just ensure the existence of informal water market, but also to support its growth for profits.

Kokapet is the village with the largest number of informal water sellers among our study villages. The number of water sellers varies from season to season, but in the summer of 2016, there were 14 water sellers as compared to two in Adibatla. In practice, Panchayat needs to give its approval for any full water tanker to leave the village. Several respondents mentioned that Panchayat regulates the movement of tankers in the village. If the Panchayat feels that the village is facing an insufficiency of water, it does not allow the tankers to sell water outside the village. This happened in April 2016. At first, the Panchayat required the sellers to sell water to the Panchayat, but when they did not do so, the Panchayat disconnected their electricity connection without which they could not extract water from bore wells. Hence, the water sellers were forced to provide water to the panchayat. Respondents confirmed that the panchayat promised to pay each seller 15,000 INR (~200 USD), but none of them got paid, except one. The water sellers stopped providing water to the Panchayat. The water sellers started using diesel generators to run their water pumps, but the Panchayat confiscated their generators. After many rounds of negotiations, the generators were returned, with a warning to provide water to the Panchayat, whenever necessary.

On further inquiry, we found that T1 K's father used to be a former MPTC member and that the Sarpanch (village headman) was on good terms with T1 K's father. Besides, T1 K also belongs to a higher caste and class family in the village. The payments were made only to T1 K based on his political status and socio-economic position. This case exemplifies a contrasting case to Adibatla. Sarpanch supports T1 K because of higher socio-economic and political status. We realised that bargaining resources such as social status and economic strengths are important aspects of informal water nexus. This indicates that actors may also want to collaborate with other actors with higher bargaining resources for future favours.

The power interplay in the villages of Kokapet and Adibatla, as described above, differ from each other in form and operation. In both cases, local politicians and authorities interact with private water sellers in which all actors exercise power based on their political position, authority and socio-economic status. In Kokapet, the Panchayat is a powerful actor, dictating terms to the water sellers. In Adibatla, the water sellers are more powerful than the Panchayat; hence, are able to carry out their operations without any opposition. However, in both cases, political position and socio-economic background have played an important role in exercising bargaining power and exacerbating inequalities. The less powerful peri-urban residents try to influence the situation, but actors such as MPTC members, local pipeline operators, water authority officials and large water sellers are often out of reach for direct negotiations.

Moreover, during group discussions, the peri-urban residents link groundwater depletion with water selling and power interplay. In Kokapet, village residents link the groundwater depletion with water tankers. Respondents mentioned that groundwater belongs to the village, but its transfer to the cities brings profit into the hands of a few. The nature of informal water market in peri-urban Hyderabad is such that higher class and caste people with the support of political connections protect the interests of a few actors.

Discussion and conclusion

Taking the peri-urban Hyderabad as our case, this article responds to two key questions. (Q1) *How do informal water tankers operate and extract ground water in peri-urban Hyderabad?* and (Q2) *What kind of power interplay exists between formal and informal actors involved in water selling?*

The study found that in peri-urban areas, the private water tankers withdraw water to be sold for use in urban areas to meet the demand-supply gap in the Hyderabad city. As a result, villagers in these peri-urban areas experience water shortages for both irrigation and household consumption. Powerful individuals operate water markets by means of tankers with strong linkages into the local government. The article also highlights that actor (formal and informal) interplay is dependent on bargaining resources such as socio-economic and political status. Water flow in peri-urban areas is a manifestation of bargaining resources and the interplay between actors.

Our findings show that the mushrooming of informal water markets may be viewed as a consequence of unorganised and unplanned urbanisation in the neo-liberal policy climate. The government takes a back seat, and markets take over the water supply and demand needs. We show that individuals with economic, social and political resources are able to get control and access to water resources at the expense of marginalised peri-urban community (Vij *et al*., 2018). The informal water market has successfully made groundwater a contested resource between peri-urban usage and urban water demands. The informal water markets become most exploitative when peri-urban dwellers have to buy their own water and sometimes have to pay the same price as urban residents are offering. Worse, marginalised peri-urban villages are losing access to groundwater as informal water markets have improved access to water for urban residents, which has led to water insecurity in peri-urban villages. Due to lack of irrigation facility and support of the government for appropriate pricing of agriculture outputs, farmers are left with no choice but to sell their agricultural land and change their livelihoods.

The informal water market directly benefits informal water sellers, local politicians and other actors involved in the supply chain. For example, informal tanker operators and reverse-osmosis plant owners/managers make profits by selling water to the peri-urban residents. Local governments have their share in these profits for allowing this market to operate. Water sellers and local politicians collaborate to bypass groundwater regulations under the WALTA of 2002, without any resistance or penalty. Formally, the local governance organisations (Panchayat and district level officials) are responsible to enforce the WALTA, but in practice they themselves are involved in the informal water market supply chain. Moreover, neither the city administration of Hyderabad nor the rural local government has regulated this market nor formalised its functioning in terms of quality, sourcing of water and price. Communities in peri-urban areas are caught in the rural–urban struggle over water resources.

To reduce the water insecurity in peri-urban areas, it is important to expose this collaboration between private water traders and local government institutions and to show how peri-urban communities are losing control and access over water resources. Further, it is also important for the state to recognize the power and politics that underlie the water access and control scenarios in these informal water markets (Shah *et al.*, 2012). Water users, policy makers, activists and scientific communities need to work towards improving the political participation of marginalised peri-urban communities that are excluded or whose voices are silenced. 'Democratisation' of water is needed so that marginalised voices are heard and included in the water debate (Finewood & Holifield, 2015; Sultana, 2018). The communities have to take measures to report water theft and fight for the rights of water. Collective action at the community level to sustain resources is pertinent (Dietz *et al*., 2003). Civil society actors and communities have

to work together to make their voices heard regarding the exploitative extraction of groundwater. Agrawal & Ostrom (1999) and Dietz *et al*. (2003) suggest that collective action from the community can influence the institutions to change the water governance in peri-urban areas, prioritising peri-urban needs and implementing conducive strategies to sustain water resources.

None of the state-level water or land policies currently consider these manifestations and subtle power interplay in their policy directives despite this being the main mechanism through which peri-urban communities lose their access to water.

Disclosure statement

The authors have declared no conflict of interest for this article.

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Received 17 February 2019; accepted in revised form 5 August 2019. Available online 26 August 2019