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Water Security in Peri-Urban South Asia
Adapting to Climate Change & Urbanization

Changing environment – changing waters:

An analysis of drinking water access of vulnerable groups in peri-urban Sultanpur

Afke van der Woude

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About the authors:

Afke van der Woude

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Design by Mohd Abdul Fahad
For further information please contact:

SaciWATERs
H.No. B-87, Third Avenue,
Sainikpuri, Secunderabad - 500 094, Andhra Pradesh, India.
Telefax : +91- 04 - 27116721, 27117728
Email : periurban@saciwaters.org

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Abstract

This article presents a study on inequities in drinking water access in the peri-urban village of Sultanpur, Haryana, India. It is based on three months of field research, in which mainly qualitative data were collected through participatory observation and interviews. The study analyses drinking water access of vulnerable groups in this peri-urban village, and the difficulties and inequity they face in this. By using the hydrosocial cycle as an analytical tool for this, water access is taken to be constituted by both social and environmental factors, with power relations having an important role in this. For both drinking water resources in the village, groundwater and a piped network supply network, processes of exclusion and inequitable access were uncovered. Significantly, these occur along lines of social identity of caste and gender. Economic and geographic factors play an important role as well. Lower caste and/or poor households face most difficulty in organizing water access. Peri-urban developments will likely create new vulnerabilities in water access, in which the poor and landless face the largest risks.

Keywords: drinking water, access, vulnerability, inequity, hydrosocial cycle, peri-urban, India

1. Introduction

This article presents an analysis of drinking water access for vulnerable groups in a peri-urban village in India. Access to good quality drinking water is vital for human life, however, access to this resource is not equally attainable for everyone. Certainly in the Global South, large differences exist. Despite many policy discourses, which regard allocation of drinking water as a 'neutral' technical question, water access is a deeply social matter (Li 2007, in Bakker 2010). Not only is it about human needs and does it involve man-made technology; it is also surrounded by interactions and power relations. Urbanization processes in developing countries pose new challenges for organization of water access within cities, but also in the areas surrounding it. These peri-urban areas face population growth, resource extraction and pollution (Narain 2009, Swyngedouw 1997). Such changes also affect water access of peri-urban dwellers, which can cause conflict and give rise to new inequities.

This study is based on my MSc thesis research (van der Woude 2013) in association with the South Asian Consortium for Interdisciplinary Water Resources Studies (SaciWATERs), as part of their IDRC supported research project on peri-urban areas. The fast growing city of Gurgaon is an example of urbanization in India. The study focuses on a village located in the peri-urban hinterland of Gurgaon: Sultanpur. It provides an analysis of inequitable drinking water access in this village, by providing insight in which vulnerabilities and inequities exist in different groups and why and how these come about. Moreover, it aims to give insight in the changes and challenges that are presented by urbanization of Sultanpur's environment.

The article will start by setting out the theoretical framework used, after which the research methodology and regional background of the study will be provided. In the two following parts, access to the main drinking water resources in the village will be analysed. It will conclude with a discussion of the research findings and some policy recommendations.

2. Theoretical framework

2.1 Political ecology and the hydrosocial cycle

By applying a political ecology approach, this study takes society and environment as mutually constituting each other. This theoretical approach focuses on how social and political processes interact with and are mediated by ecological change and how this leads to uneven and inequitable outcomes (Briant and Bailey 1997; Swyngedouw et al. 2002). Understanding the different roles of power (social, economic, political, cultural) is key in explaining the processes that produce inequitable socio-ecological conditions (Swyngedouw 2009a). Water circulation can also be seen as a process that is both physical and social. The concept of the hydrosocial cycle offers a way of studying how water and society mutually and constantly affect each other and how this results in inequitable outcomes (Swyngedouw 2009a, Linton 2011). Interventions in the water flow are inherently political and contestable, as they are determined by power relations and are likely to benefit some groups – while excluding others (Swyngedouw 2009a). This is often overlooked by policymakers and engineers, who present issues of water distribution as politically neutral and resolvable with technical fixes (Li 2007, cited in Bakker 2010). For this study of inequitable drinking water access, taking a political ecological approach means that that allocation of power and control over the water flow will be researched, and that conflicts and struggles over this resource are taken into account.

In political ecology, urbanization is seen as a socio-ecological process in which environmental and social structures are transformed and which leads to struggles over space, capital and resources (Heynen et al. 2006; Swyngedouw 2009b). Urban growth leads to formation of peri-urban areas, which often function simultaneously as urban expansion sites, resource base and dumping place for urban waste. These produced environments experience intense processes of socio-environmental change and are characterized by dynamic and conflicting processes around land, water, environment and community, both within and with other urban and rural areas. The peri-urban can be understood as a place (the fringes around cities which are transition zones between rural and urban), a process (the phase of transition) or as a concept, emphasizing simultaneous presence of rural and urban characteristics (Narain 2010b). In this study, the third approach to the peri-urban is chosen, as it is not seen as a clearly bounded place in time or space, but as a dynamic and changing area. This allows for studying rural/urban/peri-urban characteristics and their interactions and conflicts. With on-going urbanization around the world and in India, peri-urban areas are gaining significance in research as well as policy-making.

2.2 Water access in the Global South

Drinking water access in the Global South is often problematic, fragmented water networks do not service all inhabitants of urban areas, and quality and quantity of provided water is frequently poor. Unequal distribution of water access is "literally embedded in the city's infrastructure" (Bakker 2010: 49). Because of this, formal water access can be seen as a material emblem of 'hydraulic' citizenship, an acknowledgement of a right to water and a form of physical belonging to the city (Anand 2010, Bakker 2010). Such entitlements are temporary and precarious and have to be constantly defended and renegotiated. So far, most studies on such processes of inequity and exclusion are mainly carried out in urban areas (Bakker et al. 2008 on Jakarta, Truelove 2011 on Delhi). In the light of on-going urbanization, it is interesting to see how these processes play out in the peri-urban as well.
Access can be conceptualized as the ability to use or derive benefit from resources (Ribot & Peluso 2003). Hence, access is about a broader range of social relations than property rights and can also be achieved through informal or 'illegal' practices. Often, access is not achieved in direct relation to the resource, but through physical and social networks people are situated in (Truelove 2011; Coelho 2006). Thus, access is a deeply social concept, and people draw on their social, economic and political power and relations in order to access water sources. It is also a fluid concept: once obtained, access is not automatically maintained, ensuring access to water involves continuous efforts and active responses to change (Ribot & Peluso 2003). However, water access is also determined by geography and technical factors (Mosse 1997). Access is often organized through institutions: patterns of behaviour and collective action for accessing water. Institutions consist of rules and norms shaping human interaction with each other and with nature and can hence play an important role in reproducing social relations and inequities (Narain 2010, Mosse 1997).

2.3 Inequity and identity

Variety in modes of access and the political and social nature of water gives rise to inequity. In examining inequity and vulnerability, difference between groups, individuals and areas and the underlying factors for this were researched in this study. Taking insights from feminist political ecology, social identity and the micro-level of daily interactions in researching water access were specifically taken into account (Elmhirst 2011, Truelove 2011). Social identity is important in determining and shaping access to water, as inequities between groups often occur along such lines. Daily interactions with resources materialize the symbolic ideas and perceptions which result in social inequalities (Nightingale 2011, O'Reilly 2006). Differentiated interactions with water can thus be seen as constituting of identity. For understanding the practical consequences of complex relations between identity, power, access and inequity, it is important to do research on the level of these daily water-related interactions (Truelove 2011). The two main types of identity which were found to matter in this study were caste and gender.

- Indian society is structured and controlled by the caste system, which divides society in separate, hierarchical caste groups and determines people's social status by birth. The system often leads to discrimination of lower castes. The highest castes are regarded as most pure and the lowest castes have to bear labels of being unclean. Perceived uncleanliness can be transmitted by touching, sharing food, or water. This leads to physical exclusion of lower from certain spaces and resources (Joshi & Fawcett 2006). Water is important in this "as a substance that confers (im)purity" (Nightingale 2011: 156).

- Gender identities are not about biological difference between men and women, but about the social and cultural meaning attributed to this (Oakley 1972, cited in Zwarteveen 2006). Hence, gender is about both sexes. Women and men should not be seen as homogenous groups, as multiple identities exist and intersect (Nightingale 2011). Gender identities can be constructed in daily interactions with water and are often made material through 'traditional' (but socially constructed) divisions of labour around this (O'Reilly et al. 2009).

3. Methods and background

3.1 Research methodology

In order to research the issues of inequities in peri-urban drinking water access, a case-study was conducted in a peri-urban village near Gurgaon. Through prolonged and in-depth research, the social processes crucial for determining inequity were thoroughly studied, geographical and hydrological factors were taken into account as well. The case study consisted of mixed methods, with a predominantly qualitative character.

The case-study was carried out in the village of Sultanpur, where 3.5 months of fieldwork were conducted in 2012. This allowed for enough time build rapport with the villagers and carry out a thorough research. The village of Sultanpur was selected as it displays an interesting blend of traditional and modern characteristics, where effects of encroaching urbanization are becoming visible. It is home to a mixture of castes, and also shows a diverse picture in terms of drinking water resources. There are clear peri-urban characteristics present and changes in the environment are rapidly happening, hence making it an interesting case to study. The fieldwork was conducted during the hot and dry summer, which gave rise to water conflicts and scarcity. Critical events occurred during the fieldwork period, such as village hand pumps breaking down and the start of a new pipeline construction project. Hence, this provided an interesting time to visit the village.

Multiple methods were used in the research. By (participatory) observation, villagers were observed in their daily water-related routines and interactions at sites in the village. For acquiring information from the villagers about their water situation, semi-structured interviews were conducted. Different types of water users were included in the 75 interviews conducted. They varied in terms of age, occupation, wealth, household size and water resources, in order to get a comprehensive view on differences in water access in the village. An equal amount of men and women was interviewed, and most castes (see table) were included. This enabled a thorough analysis of water access in relation to identity. In these interviews, quantitative data on water usage were collected as well. Focus-group discussions were held on water issues and village politics. These were useful for identifying core issues and gaining insight in local power relations. Apart from the village water users, key actors in local water policies were interviewed: members of village government and the Gurgaon department responsible for the village water supply (PHED).

Overview of caste included in sample (numbers on castes in Sultanpur from Ranjan & Narain 2009)

Caste	Interviewed	Total in village
RAJPUT	39	600
HARIJAN	9	40
BALMIK	5	12
BAWARIA	4	6
PANDIT	4	25
YADAV	2	50
NAAI	3	20
SAINI	3	20
KHATI	1	4
KUMHAAR	1	2
BHAT	0	15
BANIYA	0	5
CASTE UNKNOWN	6	0
	77	799

3.2 Regional backgroundMap of Haryana and Gurgaon district in India (Source: Wikimedia 2012)

India, with a population of 1.2 billion, has seen rapid economic growth and urbanization in the past decades. In 2011, 31,2% of the population is living in cities (compared to 28.5% in 2001) and this is expected to grow further (Government of India 2011). This creates large challenges in urban areas, such as slum formation

and urban service provision. With urban growth comes an expanding urban footprint (Rees 1992), as resources are imported and waste are dumped outside of the city. Drinking water provision is a problematic issue in many of India's cities. Supply networks are fragmented, unreliable and often contaminated, which leads to continuous extraction of groundwater (CSE 2012). The city of Gurgaon is an example of rapid urbanization.

It is located in Haryana, close to India's capital Delhi (see map). This location, close to the national airport, makes it a favourable destination for foreign investment. Installation of special economic zones (SEZs) led to rapid economic growth and land speculation in the 1980s and 1990s. Characterized by high rise commercial and residential buildings, the city is often called India's 'Millennium City' (Sustainable Cities Collective 2011; Narain 2009). Gurgaon's population had in 2011 grown with 73.9% since 2001, to over 1.5 million inhabitants (Government of India 2011). The growth of the city is planned to continue in a newly released master plan, but recent economic downturn is slowing down these ambitious plans.

Map of Haryana and Gurgaon district in India (Source: Wikimedia 2012)

This explosive growth is putting great pressures on water and land resources in the region. The city is dependent upon water resources from outside, as many of its water bodies and green areas have disappeared. Plot that were used for agriculture or nature, are subject to urban expansion. This is disturbing the renewal of water and declining groundwater levels (Narain 2010a). Water for the city's supply network is extracted from Yamuna river, 70km outside of Gurgaon. According to municipal estimates, 107 million litres are daily supplied through the city, while at least 184 million is needed (CSE 2012). To currently meet demands, groundwater is extracted in many residential and industrial areas. Also, water tankers are often ordered to bring in groundwater from outside the city. Due to overall low precipitation, groundwater has always been an important source of water for drinking and irrigation in Haryana. The groundwater levels vary widely, but tables are falling across the state (Central Groundwater Board 2012). Groundwater resources are overexploited and In the city of Gurgaon, levels are dropping at a faster rate. Groundwater levels have fallen by 36 metres to 60 metres bgl between 2000 and 2010 in Gurgaon (Department of Agriculture Haryana 2010). This has led to attempts to further register and restrict groundwater extraction.

3.3 The case: Sultanpur village

The village of Sultanpur is located in Gurgaon district, at 15 kilometres from Gurgaon's city centre, on the highway from Gurgaon to nearby small-town Farukh Nagar. There is a railway line running through the village area, to which Sultanpur is also connected with a train station. The area around Sultanpur consists of sloping terrains and has many agricultural fields, where grains and vegetables are cultivated. Adjacent to the village is the Sultanpur Bird Sanctuary, a small national park and bird-watching site. Sultanpur has 5000 residents and consists of 800 household, according to village records s. It is home to a variety of castes, of which the higher Rajput caste is predominant with 600 households. Lower and scheduled castes living in the village are Harijan, Balmik and Bawaria (Ranjan & Narain 2012). Though different castes live close to each other, there is some form of spatial segregation: most low caste members live at the outskirts of the village, on lands administered by the village council. As these lands are communal, lower caste households residing here do not have land ownership. Many Harijans live on the east-side of the village; the Bawaria reside on a hill in the west; and south of the railway line is a settlement where mainly Balmik and Harijan households live. As lower caste groups are generally poorer than others, which is visible in these areas.

The village is governed by the gram panchayat, which consists of panches elected from each of the eleven wards of the village, and which is headed by a separately elected sarpanch. This village headman has a powerful position in the village. The panchayat is responsible for water provision and sanitation in the village, together with a regional government department, the Public Health Engineering Department. This government department is located in Gurgaon and responsible for public water provision in the old city and the surrounding villages. The panchayat makes plans and can request the PHED to approve carry out these (Government of Haryana 2012a). Together, the panchayat and PHED are responsible for maintenance of the two main sources of drinking water in Sultanpur: groundwater and a piped supply network, which will be further analysed below.

An increasing amount of construction projects and rising land prices are signs of urbanization in the area of Sultanpur. According to elderly residents, Sultanpur used to be a 'typical farming village'. This changed with increasing levels of education and more and more people working in the city. Urban growth is by many villagers seen as an opportunity for jobs and doing business. They hope it might lead to further development, improving local infrastructure for water provision and electricity. Currently, most inhabitants still regard their village still as a rural place. 'Village life' is perceived as cleaner and healthier than living in the city. Urbanization and accompanying pollution are seen as a threat to this. Elderly villagers are already complaining about erosion of village traditions, saying that people are becoming more individualistic, and the sense of community is disappearing. Rising land prices create opportunities for landowners, who can make profits by selling their lands. This poses threats for land labourers, as they are dependent on agriculture for their income. Hereby, peri-urbanization is creating new economic inequities between landlords and labourers, visible in the increasing number large pucca houses and big cars in Sultanpur. Peri-urbanization leads to mixed effects in Sultanpur, and its consequences will become more clear in the near future.

Gurgaon's growth has consequences for water access in the village as well. There is a risk of competition over water with the city in times of scarcity. However, the village benefits from relation with PHED (from Gurgaon) in the form of installation of a water supply network. Declining groundwater levels and accompanying salinization of resources are a serious issue in the region, affecting both household water access and agriculture. This is caused by a combination of over-extraction locally, as well as in Gurgaon. If this is not combated, many water resources are under serious threat of becoming undrinkable. Changes in groundwater quality have their effect on agricultural practices: increasing salinity limits farmers in the options of crops they can grow. Instead of more profitable cultivation of leafy vegetables and flowers, they have to switch to growing grains and mustard. When salinity further increases, even these crops will be impossible to grow. Some farmers are already making decisions to sell their land and moving to live in the village, because they do not see a sustainable future in their occupation.

4. Network supply

Since approximately 8 years, Sultanpur village has a piped network that provides household water supply. This was installed by the PHED, and links up to the Gurgaon Water Supply canal. Two large reservoirs outside of the village (capacity of 20.000 and 160.000 litres) are filled with water from Gurgaon's treatment plants One of these reservoirs is designated for supplying the bird sanctuary with water, the other one is for the village. A network of cement pipes supplies this water through the village. By boring a hole in the pipe and sticking in a pipe, households can connect their homes to this network. The water supply is pumped through the village with use of an electric pump. It is supplied in alternate turns to 7 different parts of the village, through a system of pipes and valves. This system is co-managed by the PHED and panchayat. An operator is appointed by the sarpanch for opening and closing all the valves in turns.

4.1 Quality and quantity of the water supply

Though 70% of households is connected to water supply, only 24% of these chooses to use this water for drinking. Most people prefer groundwater for drinking, as they do not trust the quality of the water supply. Water users claim that the water is polluted with sand and that the filtration process is unreliable. This is disputed by the PHED, who argue that the water itself is clean enough and contaminations can only occur after transport, through breakages in the cement pipes. However, many people indicated not to trust the original (river) source. Stories are told of it being polluted with garbage and sewage, and hence not a safe source of water. These stories cause many people to rely on groundwater for drinking. No official public water testing has ever been conducted in Sultanpur, so there is no objective knowledge available. Still, 24% of the people interviewed choose to drink the water supply without problems, saying that many villagers are 'just superstitious.' This situation illustrates how influential perceptions and narratives are in choices for water resources. Because of the mistrust of the water quality, many people employ filtration methods before drinking it. The traditional and cheapest method for this is to strain the water through cloth and dirt settle at the bottom. This does not filter out bacteria and germs. The method of cooking water is not much used in Sultanpur, but reverse osmosis (RO) technology is applied by some households. With this membrane-filtration method, dirty water can be made potable. This is a relatively new and expensive technology (purchasing costs are 15.000 – 20.000 INR, regular maintenance is needed), and therefore only available for affluent households. An estimated 10% of households have invested in an RO system. Fort those who prefer to drink groundwater, the water supply is an important source for other household chores.

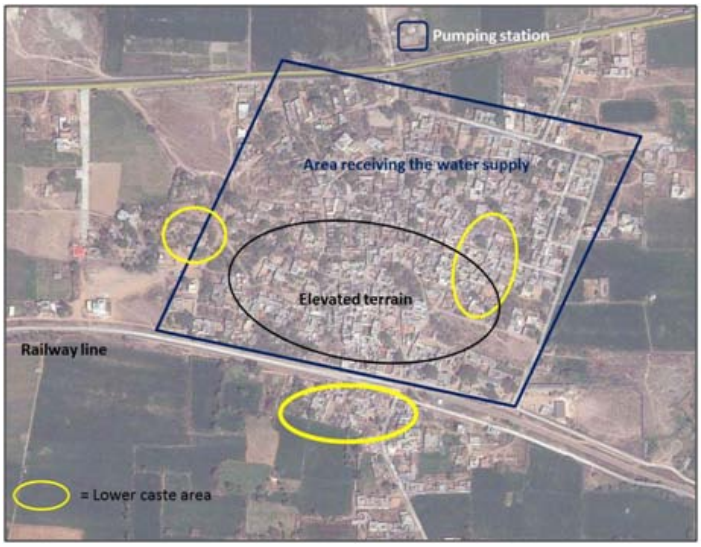
As per official government guidelines, village residents should receive 75 litres of water per head per day. However, not enough water is supplied to the village for this, the main tanks are only filled once in two or more days and hardly ever completely full. As electricity is available on alternate days, water can be pumped through the village on these days only. Frequent power outages cause the supply to be erratic and unreliable. Though water needs differ per household, depending on household size, the average estimate of potable water needed by water users was three matkas or 45 litres per household. This water is used for drinking and cooking. More water is needed for other household activities such as cleaning, washing and

bathing. There are a lot of complains about the quantity of the water supplied. It comes for maximally 30 minutes on alternate days, but often less. The amount provided is often not sufficient to fulfil all household needs. The manual operation of the system, the dependency on erratic electricity, and unreliable supply to the main tanks from the city causes variety in amounts of water supplied. Moreover, less water is supplied to areas far away from the main tank and lying on slopes. The capacity of the motors pumping the water through the village is not sufficient to reach these remote and uphill places. Thus, location determines who gets how much water from the supply.

Technology also has an influence. Motorized pumps are used by more remote households to pull water up to their places. These technologies are not affordable to everyone, and their widespread usage negatively affects the amount of water available for those who cannot afford such pumps. They can also cause extra pollution, by pulling up dirt through the pipes. The ease with which connections can be taken from the network leads to some households having more and bigger connections than officially allowed. Hereby they can take more water from the supply than households that follow the guideline of one connection of 6mm per household. If connections are not properly made, dirt can come in, and hence pollute the water supplied to other users. Hence, the interdependencies between the users of the network and their practices affect both quality and quantity of the supply. It seems that most villagers see the water supply as an individual entitlement, instead of a common-pool resource, which is reflected in user's practices of securing enough water for themselves. Accusations of others misusing or over-consuming the water show however, that there is awareness of the inter-linkages between water users through the network. The insufficient quantity and quantity of the water supply causes difficulty for people depending on it and keeps dependency on groundwater in Sultanpur high.

4.2 Unconnected locations

Of the households interviewed; almost 30% are not connected to the piped network, because the network is not extended to those places. People residing here have to depend upon alternatives, i.e. groundwater. As lower castes communities mainly reside at the village periphery, they are generally less connected to the network than other villagers. This means that they have to do a lot more work to fetch water for all household chores. Moreover, it enhances stereotypes of being 'unclean'.



Source: van der Woude 2013, adapted from GoogleMaps 2012.

The map illustrates which areas are serviced by the network: households outside of the village boundaries and the settlement beyond the railway line are excluded. According to the authorities, this is caused by restrictions of the railway department, who do not allow pipe construction underneath the tracks. The area south of the railway line contains one of the largest lower caste settlements of the village (Harijan and Balmik). The low social status of these people makes connecting the area to the supply network a less pressing political issue. Perceptions of the low castes being unclean might make them less suitable and deserving for being connected to the water supply. Interesting is that availability of sweet and potable groundwater is quite high in this area. This makes it a popular area to settle and buy land, despite the lack of PHED supply. Affluent households can afford to buy land here and install private submersibles. This availability of groundwater makes political necessity of bringing the supply there even less. Lower caste households are generally unable to benefit from the groundwater, as they are unable to afford technologies for extracting it.

4.3 Politics and regulation

Village politics play a role in determining where and how the grid is constructed, with negative effects for the areas excluded from the supply. Internally, the water supplied through the network is also contested. One area in the village receives water through a metal pipeline, and thus with more force and less chances of contamination. This is the line leading up to the area where the sarpanch and his family live. Thus, many people accused the sarpanch of using his power towards his own benefits. According to the sarpanch, the pipeline is the start of a wider improvement project that will soon be carried out in which the whole village will be served by metal pipelines, but that is not how it is generally perceived in the village. There are also persistent accusations that there is difference in the time that the water supply is left running to the different

sides of the village, benefiting the richer and powerful areas. Also in the working relation between the PHED and panchayat, village politics are of influence. "Village politics are a major hassle for the PHED. Often after elections, ruling parties will try to benefit themselves. It is a lot of trouble and extra work for us to deal with," the subdivisional PHED engineer explained. Since the sarpanch forms the main line of contact and source of information between the PHED and village, he has an influential position.

For the PHED, illegal water connections are a problem: they perceive unregistered connections as 'water theft'. Formalization of the connections is a recent measure, to enable a billing procedure. Many households still do not have the official files made for this. Of those who did (only 10 of interviewed households), only a few have started to receive bills and not all of them are willing to pay the fee of 20INR per month. Even though this is perceived as a small amount of money, the quality and quantity of the water supply is deemed insufficient. And with paying bills, the water users have higher expectations of the supply. A move towards paying for water can affect poorer households negatively, as it does form an extra financial burden. For the PHED officials however, the issue of paying bills seems a matter of disciplining water users in behaving 'properly', by formalizing connections and combatting wastage.

This is important in the light of a new project that is undertaken by the PHED: replacing the cement pipelines with new metal pipes. The project will enhance water quality and quantity, because metal does not break as easily as cement. Hence, there will be less contamination of water and it will flow with more pressure. The villagers are sceptic of this initiative. In their eyes, the water is still originating from a polluted source and the overall quantity supplied to the village will not automatically improve. Moreover, the project had already been delayed by months, so it seemed unlikely to become realized any time soon. Wider implications of this proposed project are that it will be easier for the PHED to prevent illegal connections to the network. Standardized connections will lead to more equity between those who have a formal connection to it. This might exclude those who do not have a 'file made' and currently have an informal connection to the network. Moreover, the project will not address those vulnerable groups currently excluded from the network, as there are no plans of extending it to unconnected areas.

5. Groundwater

5.1 Quality and salinity

Groundwater is the traditional and most used drinking water resource in Sultanpur. For almost 75% of the households interviewed, groundwater is the main drinking water source. In the past, groundwater used to be extracted via wells. These have since 10 years all gone dry, due to falling groundwater tables. The only way to access groundwater resources now, is through boreholes. According to the PHED, groundwater tables around the village have dropped from 18-20 metres bgl in 1985, to over 35 metres bgl. Salinity of the soil also influences groundwater availability. With declining groundwater levels, more and more sources are becoming saline. This makes them unsuitable for drinking, cooking or making chai (as it makes milk split). It is also less appropriate for washing and bathing, since soap does not mix well, and it causes corrosion of the iron water pumps. There seems to be a common base of knowledge among the villagers about which resources provide adequate drinking water and which are of lesser quality. This translates directly into people's actions: distinguishing between water sources for different purposes. The on-going process of declining groundwater levels and salinization are a source of concern. The process is causing new vulnerabilities for those dependent on groundwater, and as all people in Sultanpur are using groundwater in one way or another, the effects of this process are not to be underestimated.

5.2 Public and private access

Groundwater is publicly accessible through hand pumps installed and managed by the panchayat. There are 12 of such publicly and freely accessible pumps in Sultanpur. They hand pumps are placed on public lands. There is also a number of semi-public groundwater sources in the village. These are handpumps which are generally freely accessible, but located on private land, which can cause disputes over who has the right to these waters. Not all of the public and semi-public hand pumps provide sweet water: some have gone dry or saline and are not used for drinking. Only 6 hand pumps in the village are frequently used for fetching drinking water. The majority of the population of Sultanpur (69%) is dependent upon public or semi-public resources for drinking water. For most people a hand pump is reachable within several hundred meters, a distance that matters when it has to be walked daily with heavy water pots.

Groundwater can also be accessed privately, as landowners have the right to extract water from their land. About 30% of households has access to a private groundwater source that is suitable for drinking. Even more households have access to a private groundwater source that is not suitable for drinking, but which can be used for other household chores. These people have to rely on one of the other resources for their drinking water. For installing a private well or pump, registration is needed nowadays. This regulation has been put in place for agricultural and industrial tubewells and might soon be applied to domestic pumps too, in order to control groundwater extraction. It is difficult to check to what extent this is actually carried out and controlled.

Different locations have access to different qualities of groundwater. It depends on the location of the household (and the land belonging to it) whether the groundwater is potable. The price of land with sweet groundwater access can be up to 15% higher than that of land with saline water, according to village farmers. Settlement patterns in the village keep changing along with availability and quality of the groundwater. The presence of the public water network in the village mediates these moving patterns, since it provides an additional water resource for many households. Low caste households living in areas with good quality groundwater might be negatively affected by these moving patterns. If these lands become more in demand, they might be pushed to move away. Since the lowest castes do not hold land rights, this could have serious consequences: they could be driven from their houses. They are rendered at the hands of village politics, as the panchayat is owner of and can make decisions about the land they inhabit. Moreover, since buying land with sweet groundwater access is not affordable for many people in the village, access to groundwater is partly determined by wealth, also in relation to the different technologies described below. This is why richer households have more opportunities to access good quality groundwater resources.

For all ways of accessing groundwater in the village, it is necessary to bore deep holes in the ground in order to reach the groundwater reservoirs. This involves costs, effort and additional technology. Hence, accessing a private groundwater source is not affordable for everyone. To further ensure access, a number of different technologies is available, varying in efficiency and affordability:

- With a hand pump, groundwater can be extracted by use of physical labour. This is a comparatively cheap technology, but there are limits to the depth of water it can reach. All public groundwater points are hand pumps.
- The most popular method to access private groundwater resources is by use of a submersible pump. These motorized devices run on electricity or fuel and can pump up water without physical effort . A small motor is put below the ground and can draw water up from depths of 30 metres. Submersibles are more expensive than hand pumps, and electricity or fuel bring extra costs.
- Another technology holds the middle between a hand pump and a submersible: the jet pump. Whereas a submersible motor is placed underground, this pump has a motor above the ground and functions like a motorized hand pump. This is cheaper than a submersible, but cannot reach the same depths.
- Additionally, inverters are used to generate some hours of electricity back-up. They are quite popular among wealthy households, who also use it to secure groundwater access.

Many of these technologies are not affordable for poorer households, which makes these options for obtaining groundwater access out of their reach.

5.3 Sharing and interdependencies

The groundwater resources in the village have to be shared among all villagers. A case of literal water sharing became interestingly clear when main hand pump in the area south of the railway line was broken. It uncovered vulnerabilities and coping strategies in this part of the village, which is excluded from the water supply. The people most affected by the broken hand pump were lower caste and poor households, without access to private groundwater resources. Alternatives for them were drinking saline water, walking (longer) to other hand pumps, or asking people with a private water resource for water.

Asking for water is considered a lower caste practice, but is even in these groups not commonly practiced. Lower caste members themselves said to not like 'begging' for water, so this is only resorted to in times of need. When having to do this, people rely on social relations and go to people where they expect to succeed. The practice has a link to religion, in which where giving water to the thirsty is considered a good deed and good for one's karma. Hence, this collective pattern of behaviour can be seen as a village institution for water provision to those in need. Though this institution is broadly acknowledged to exist, it does not form a regular flow of water. There is a relation of dependency between owners and users of water sources. People asking for access to someone's private resource have to adapt to the owners' conditions of use. The following quote of a lower caste woman makes the uncertainties they face clear: "Sometimes they let us fill up our pots, and sometimes they don't. Some people never let us in."

In the area around the hand pump, it was observed that more plot with private hand pumps were opened for others to use. However, most of these were only accessible when the owner was there and with his / her permission. It also happened that owners did not let some people asking for water in. This is related to caste prejudice: finding it inappropriate to let lower caste members on one's premises. Thus, members of a higher caste can mobilize two discourses for justifying a choice whether to give water or not: lower castes are unclean or it is a good deed to provide them with water. This causes uncertainty for lower caste members who are depending on these resources, when asking for water they constantly have to negotiate access to other people's resources.

5.4 Caste

Other caste related water practices could be observed during interactions at the public hand pumps. An interesting practice observed, was that some higher caste women clean the hand pump before filling up their pots, if it has been used by a member of a lower caste before them. With this cleansing ritual they confirm status differences and labels of uncleanliness. Through performing these rituals, caste relations and perceptions are being reproduced. Lower caste members mainly complained about the time that the higher caste ladies took in carrying out this practice. Moreover, there were many complaints of higher caste members cutting in line. Hence, lower caste members have to wait longer for their turn. To avoid such hassle and arguments about this, some lower caste members prefer using hand pumps which are less busy – but farther away and/or of lesser quality. This shows how through daily interactions at hand pumps and the way people adapt their behaviour accordingly, status differences and power relations are constantly expressed and reproduced.

From higher caste members, I often heard the complaints that lower caste members do not know how to use the water properly. A Rajput man commented on Harijan water use: "The government has made them equal, which we understand. But they should also look at the other side, that these people do not have any common sense. They just won't listen to us, it's how their community is. I preferred the way it was before, when us Rajput did not let them on our lands." Other higher caste members often describe 'them' (lower castes) as ignorant people who do not know how to behave properly. These prejudices are expressed in interactions the groups have with each other, at public hand pumps, where discussions and arguments about 'appropriate conduct' can often be heard.

Though officially abolished, it is clear that caste prejudices are still present in social relations and daily interactions between the villagers and in their dealing with (ground)water resources. Lower caste members have to deal with discrimination and prejudice. However, the caste label is not all-determining: economic status and location of the household also influences options for water access, and internal differences exist within caste groups. Poor higher caste households also struggle with issues of water access, whereas relatively well-off lower caste households are able to afford technology which alleviates their situation. Many villagers indicated that caste relations are changing and modernizing, due to policy changes and interactions with the city. Discrimination and physical exclusion are decreasing, but caste ideas are still in place: "Everybody in the village is equal in practice, but not in thought."

5.5 Gender

In organizing household water access, gendered divisions of labour are visible in Sultanpur. Women are responsible for many water related household tasks, such as cleaning, washing and cooking. The introduction of the PHED supply greatly alleviates the workload of women compared to the past, when those who did not have access to a private water resource had to manually fetch water for every single chore.

During the day, many men are away to work on the fields or in the city, while the women stay at home to do the household work. However, for many women tradition dictates that they stay inside the house (premises) and do not leave this alone. This tradition of purdah which is part of the lifestyle of the higher castes (Rajput, Pandit, Bhat), also means that they cannot go the public hand pumps for fetching water. In these groups, water is fetched by the men or children after school or work, or sometimes by the elderly. If applied strictly, it can mean that women in purdah have to wait at home until a family member is able to fetch water for them. Lower castes do not practice purdah, in these households role pattern are less defined; 'whoever can carry a pot fetches the water.' Not practicing purdah reflects negatively on the social status of these women, making them less feminine. This illustrates how gender and caste identities intersect and how such identities are given meaning through water practices. Modernization and influences from the city make that traditional role patterns are subject to change. With more men working in cities of Gurgaon and Delhi, this sometimes forces women in purdah to go out for water anyway. However, new technologies and services can also make it easier to keep purdah: such as the PHED supply coming to the premises, or the installation of an RO filter, ensuring good quality water. Since these options are not affordable for everyone, ability of practicing purdah is becoming a more exclusive symbol of social status.

In group discussions, women seemed more concerned about quality and quantity of household water than men, since they are the ones directly working with it. Men do not directly face these issues and seem more concerned with scarcity of water in relation to practicing agriculture and doing construction work. Both within the household and within the village context, women have less power and influence over the (water-related) decisions that are made. As one lady explained, they might be doing their job of finding solutions too well: "We complain to our husbands about our water worries, but they are tired when they come from work, and the water is there, because we take care of that. So they do not feel these issues enough to do something about it." In general, there was a sense that women have less influence on village politics, as well as lower caste groups. They are underrepresented in the panchayat and have little faith in the outcomes of political process.

6. Conclusion and discussion

In Sultanpur, access to drinking water takes a variety of forms, due to varying hydrological conditions and different technologies available. Water from the piped supply network and groundwater form the two main drinking water sources. These water resources are accessed in different ways and are used for different purposes. It has become clear that household drinking water access to these sources is not equitably distributed in the village. Large differences exist in terms of type, quality, quantity and security of drinking water access. Hence, the case of Sultanpur presents a diverse water picture in which some groups face more vulnerability then others. A study of water access with use of the hydrosocial cycle illustrates that water cannot be seen apart from its social context. It is permeated with cultural beliefs, power relations and social practices (Swyngedouw 2009a, Linton 2011). Access is co-constituted by social and environmental factors and in turn, distribution of water has consequences for social relations and the environment.

The grid of the piped water supply is political and contested (Coelho 2006). Power relations have determined the way it has been constructed, with influential roles for the sarpanch and PHED. The groups excluded from connecting to the supply are mainly the marginalized lower caste groups who have to live on the boundaries of the village or behind the railway line. Extending the supply to these areas would mean great alleviation of the water burden of these groups. However, they are not able to present themselves as a 'deserving' political group for receiving hydraulic citizenship by getting connected to the water network (Anand 2010, Bakker 2010). Internal differentiation in the network is partly caused by geographical conditions, user practices and the operation of the system. Affluent households are able to afford mediating technologies, to which poorer households do not have access. Hence, network is benefitting those with money and power more than those with less means and influence. This inequitable access creates vulnerabilities for lower caste and/or poor households. Recent initiatives by the PHED and panchayat to improve the network are aimed at internal improvements of the network rather than connecting the excluded areas. This indicates that political priorities focus on consolidating control of the network, instead of including marginalized groups.

When it comes to groundwater, caste and economic status also play an important role in determining people's access. Low income households are largely dependent upon public hand pumps. Moreover, lower caste members face discrimination in accessing certain groundwater resources, in the form of exclusion, having to wait longer or accusations of misconduct. Through these daily experiences, caste relations are constantly reproduced, and this creates inequitable social positions. Inequities between caste groups relate partly to inequities in wealth and hence in choices for location and technology. Gender is also found to matter for water access. While women mainly carry the physical burden of water fetching for the household, they can exert little influence on water-related decision making. Gender also intersects with caste identities (Nightingale 2011), which is illustrated in the practice of purdah. Identities of caste and gender are given meaning through water practices and social difference is reproduced and made material (O'Reilly 2006; Nightingale 2011). This shows how the relation between identity and access is two-way: identity is constituting of access, water access is also constituting of identity.

Thus, this political-ecology analysis leads to a conclusion that women, lower caste and poor groups face greatest difficulty, since they have the least social and economic power. Institutions for organizing water access in Sultanpur reproduce inequitable power relations and lead to uneven distribution of access. This shows in the workings of the PHED supply, underrepresentation of vulnerable groups in decision-making bodies, but also in traditional water sharing institutions which reaffirm relations of dependency. Taking society and the environment as mutually constituting, this study has shown how there are close relations between e.g. location of the household and income, social status and water access. Hence, the spatial characteristics of water access co-create inequitable distribution of resources (Swyngedouw 2002).

Communities, institutions and water practices are deeply rooted in their social, cultural and geographical context (Mosse 1997, Mehta 2001). Hence, the peri-urban context of this research matters. Signs of both urban and rural characteristics are visible in the area around Sultanpur. Because of the growth of Gurgaon, Sultanpur is experiencing both environmental changes and changes in social structures, institutions beliefs and traditions, both of which have consequences for drinking water access. The changing situation creates new opportunities, by for instance challenging tradition beliefs about caste / gender and new means of employment, but it also poses threats. With declining groundwater levels, drinking water is likely to become an even more contested resource. It seems that affluent inhabitants of Sultanpur are more likely to benefit from peri-urban change, by for instance selling property, whereas poorer villagers might face larger struggles and uncertainty in the future. With more and more groundwater sources going saline, this will pose challenges for those depending on this resources for all their water usage.

6.2 Policy recommendations

Some policy recommendations were formulated on the basis of this research, for improving the water access of vulnerable groups in Sultanpur, and taking into account peri-urban developments.

- Include the currently marginalized groups more in the decision making processes. Women and lower castes should be better represented in the panchayat and consulted by the PHED in planning process.
- Ideally, the water supply network should be extended to the area currently excluded. Otherwise, alternatives should be found for organizing equitable water access for all people residing in this area.
- In order to improve the quantity of water supplied, initiatives for combating water wastage could be taken: installing taps on the connections to water supply, making villagers aware of the inter-linkages in the network, and checking the size and number of connections taken by villagers.
- Ensuring sufficient water being supplied from Gurgaon to the village is a responsibility of the PHED. On higher policy levels: the overall quality and quantity of water supplied to/through the Gurgaon district and city should be increased. For this, large investments in infrastructure are needed.
- Improving the quality and quantity of the piped water supply can help in combating over-extraction of groundwater. Other useful measures are: more control and regulation of private groundwater resources, but also ensuring sufficient recharge of groundwater levels during the wet-season.
- The option of rainwater harvesting and storing should be researched and tested in the village. This can form a sustainable additional water resource for household or agricultural water use, and hence decrease pressure on the currently exploited water resources.

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Water Security in Peri-Urban South Asia

Adapting to Climate Change & Urbanization

Water Security in Peri Urban South Asia: Adapting to Climate Change and Urbanization

Working primarily on water security issues in Peri-Urban South Asia, across India, Bangladesh and Nepal, the project's main concerns are the rapidly changing peri-urban landscapes due to urbanisation and implications for water security in specific locations in the larger context of climate change. As an action research project, working across four locations in South Asia, it will serve as a basis for capacity-building at the grass roots level to address concerns of the poor, marginalised and other vulnerable communities to water security and seek to understand the dynamics of adaptation in the specific locations, for action and policy agenda at the regional level. It will build their capacities to cope with climate change induced water in-security.

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