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Discussion Paper Series

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

Urbanization, climate change and water security:

A study of vulnerability and adaptation in Sultanpur and Jhanjhrola Khera in peri-urban Gurgaon, India

Pranay Ranjan and Vishal Narain

This paper describes how urbanization and climate change shape water insecurity in two villages, namely, Sultanpur and Jhanjhrola Khera in periurban Gurgaon in the North-West Indian state of Haryana. Using ethnographic and participatory approaches, it documents the people's lived experience of a changing climate and water insecurity. While urbanization and climate variability alter the availability of water, the effects of this are aggravated by a complex interaction of caste, class, gender and locational factors. The most vulnerable are those whose identities are constructed at the intersection of these factors. The paper then describes the wide range of social, economic and institutional factors that shape the periurban residents' adaptive strategies.

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This is one of a series of Discussion Papers from the Peri Urban Project of SaciWATERs.

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Urbanization, climate change and water security: a study of vulnerability and adaptation in Sultanpur and Jhanjhrola Khera in peri-urban Gurgaon, India

Pranay Ranjan[1] and Vishal Narain[2]

1. INTRODUCTION

A recent newspaper article in The Times of India (TOI), a popular national daily, pointed out that Delhi, as a city, receives more migrants than any other state in the country (Mukerji, 2011). Gurgaon, a part of the Delhi NCR (National Capital Region), has not been left untouched. In fact, migration to Gurgaon city has led to urban outgrowths in continuation with the municipal boundaries of the city. As per the provisional 2011 census data, the total population of Gurgaon district stands at 1,514,085 (Census of India, 2011). Although Gurgaon ranks 4th among the 21 districts in Haryana in terms of total population, there has been a tremendous rise in the decadal growth rate of population over the period 2001 to 2011 (ibid.). As per the latest data available with the Census of India, Gurgaon district has observed a population growth rate of 73.9 per cent, which is highest among all the districts in Haryana (ibid.). In fact, the closest decadal population growth rate, observed by any other district in Haryana, is 37.9 per cent for Mewat (ibid.).

A mix of favourable tax and industrial policy and proximity to the national capital of India has led to rapid urbanization of Gurgaon (Narain, 2011; Mohan et. al., 2011). This has also led to its emergence as a major real estate and outsourcing destination of northern India (Mohan et. al., 2011). However, the development of any city is incumbent upon a corresponding growth in infrastructure. This brings out the importance of peri-urban regions, which act as a resource base for the city and provide the much needed land and water for urban expansion. Many scholarly articles have delved into defining and understanding the term and the associated dynamics (Halkatti et. al., 2003; Narain & Nischal, 2007; Marshall et. al., 2009; Cammack, 2012). Peri-urban is an area or a zone in the vicinity of an urbanizing centre, which is in a state of constant flux with respect to exchange of goods, services and resources, not limited or defined by a geographical boundary, but characterised by social and economic heterogeneity, institutional lacuna, multiple and competing claimants to resources and increased vulnerability of marginalised communities. The definition as well as understanding of the peri-urban concept for this paper is in line with the conceptualization used in the IDRC supported Peri-urban Water Security Project (Narain, 2010). Thus, peri-urban is not considered in its narrow, geographical sense but from a perspective of studying and understanding the relationships between rural and urban activities, processes and institutions, especially in the context of water.

This paper shows how urbanization and climate change shape the water (in) security of peri-urban residents in two villages – Sultanpur and Jhanjhrola Khera. These two villages are the intervention villages under the IDRC supported project Water Security in Peri-Urban South Asia – Adapting to Climate Change and Urbanization. The paper describes the different ways in which urbanization and climate change affect peri-urban water security and the wide range of factors that shape peri-urban residents' adaptive responses and strategies. Water insecurity is as much of a social construction as it is a physical one; it is shaped by a complex interaction of caste, class, gender and locational factors. The most vulnerable are those whose identities are constructed at the intersection of these. The peri-urban residents' adaptive responses are shaped by a wide range of socio-economic factors such as their economic status, access to social capital and location in systems of land tenure that allocate resources and inputs in the context of agricultural practices.

The methodology is predominantly qualitative drawing upon a mix of ethnographic and Participatory Rural Appraisal approaches. It draws on semi-structured interviews with peri-urban residents, meetings with key informants and focus group discussions. PRA tools such as seasonality analyses and trend lines were used to assess elements of climatic variability and adaptive responses in terms of cropping choices. Quotations are used at different points in the paper to capture the study members' lived experiences of urbanization and climate change.

2. SULTANPUR VILLAGE

Sultanpur village is located about 16 Km. from Gurgaon city on the Gurgaon-Farrukhnagar highway. As per the records available with the Patwari – the village level land record keeper, the total land area of Sultanpur village is 4,387 acres. Out of this, about 4,011 acres of land is cultivable and the remaining 376 acres is non-cultivable. The village has an approximate population of about 5,000, of which 2,200 are eligible to cast their votes. The total number of households is about 800. Out of these 800 households, about 200 are situated in

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the Dhaani. The migration of people to the Dhaani has been attributed mainly to easier water access.

On the one hand where division into muhallas has historical rooting, the division into wards is a more recent phenomenon and has mainly to do with the electoral process. In total, the village has 11 wards. From each ward a representative is elected, who is called a Panch. All the Panchs, along with the Sarpanch or the village headman, constitute the village Panchayat.

Sultanpur is home to a motley of castes, Rajput being the dominant one, in terms of number as well as land ownership. The table 1 below lists the different castes inhabiting the village and the corresponding approximate number of households.

Table 1: List of castes and corresponding number of households in Sultanpur

Caste	Number of Households
Rajput	600
Saini	20
Baniya	5
Yadav	50
Pandit	25
Bhat	15
Harijan	40
Balmik	12
Khati	4
Kumbhaar	2
Bawaria	6
Naai	20

Source: Village Participatory Rural Appraisal (PRA)-2011)

An important feature of the village is a rail route that passes through it. The current visual picture gives an impression that the villagers settled on both sides of the rail route. However, it was found that earlier the village settlements were confined only to the section towards the highway. With the passage of time, people started settling beyond the railway line primarily because of sweet groundwater. Thus, it is clear that the availability of water is an important factor that has shaped the settlement pattern in Sultanpur, as both the settling down of village residents in the Dhaani, as well as settling beyond the railway line, was triggered by the availability of sweet water. Another very striking feature about Sultanpur village is its undulating terrain. As one enters the village from the Gurgaon-Farrukhnagar highway, one can easily see that some households are located on an elevated terrain, whereas other households are on level ground. These features prove to be very crucial in determining water access of villagers and are important factors shaping their water (in) security.

3. JHANJHROLA KHERA VILLAGE

Jhanjhrola Khera village is located about 19 Km. from Gurgaon city on the Gurgaon-Farrukhnagar highway. As per the records available with the Patwari, the total land area of the village is about 596 hectares. In local land units, 596 hectares corresponds to 11,919 Kanal and 11 Marla.

Out of the total land area, about 516 hectares of land is fit for agriculture, whereas the remaining 80 hectares is non-cultivable.

As per the Nambardar, the total population of the village is 4,854, out of which 1,854 are eligible to vote. The voting population is divided into 10 wards, with members ranging between 140 to 180. Khera, being bigger in terms of population as well as number of votes than Jhanjhrola, has 6 wards. The remaining 4 wards are in Jhanjhrola. Each ward has an elected leader, called Panch. Thus, a total of 10 Panchs and 1 Sarpanch form the Panchayat of Jhanjhrola Khera.

As per the number of ration cards issued in the village, the total number of households is 689. Out of these

689 households, about 40 to 50 are situated in the Dhaani. The different castes inhabiting the village and the corresponding number of households (See table 2).

Table 2: List of castes and corresponding number of households in Jhanjhrola Khera

Caste	Number of Households
Rajput	60
Yadav	227
Pandit	25
Harijan	24
Balmik	16
Jaat	125
Kumbhaar	1
Naai	10

Source: Village record keeper (Nambardar)-2011

Although Yadavs are the dominant caste in terms of number, Rajput and Pandit are the castes with maximum land holdings. Harijan, Balmik and Naai are the castes without any land holdings. Looking at the caste composition from a more micro level, all Rajputs and most of the Pandit families are from Jhanjhrola, whereas, Yadav and Jaat families are from Khera. Like Sultanpur, migration of people to village Dhaani is because of easier access to one's field and access to sweet groundwater. In case of Jhanjhrola Khera, an additional reason could be an easier access to the main road, as the village settlement area is poorly connected to the highway. As in the case of Sultanpur, a very important feature of the village is its undulating terrain. This feature proves to be very crucial in determining water access of villagers and is an important factor shaping their water (in) security. Another important feature is the dynamics associated with removal of illegal water connections and their legalization.

4. Water sources and the decline of CPR institutions

Taking an overall view of the water sources, the groundwater is predominantly saline in Sultanpur and thus not fit for drinking. However, as noted earlier in the paper, a section of the village – beyond the rail route – has sweet water and meets the drinking water requirement of villagers. The groundwater table level is varied, especially in the settlement and cultivable area of the village, and is in the range of 30 feet to 80 feet. The saline groundwater is mainly used by the farmers for irrigation and sometimes as an alternative source of water for daily household chores in the absence of water supplied by PHED (Public Health and Engineering Department).

The village Johads or ponds are the main sources of surface water. However, their utility remains confined mainly to rainy seasons, since they remain dry during other seasons. The year 2010 was an exception, as heavy rainfall in this year ensured that the Johads remained filled with water even during late winter months. In all, Sultanpur village has three Johads- Ram Sharan, Duppata and Rana waala. The Johads are however in a dilapidated state. One among the three Johads mentioned above receives the village's drain water. The other two Johads prove to be of use only during the rainy season. They are mainly used as an alternative source of drinking water for village cattle.

Like Sultanpur, the groundwater in Jhanjhrola Khera too is predominantly saline, with minor variations in terms of water quality at some places. This water is mainly used by farmers for irrigating their fields. The main source of water for household consumption is the piped water supplied by PHED. Some households have personal bores in their house, either in the form of tube-wells or hand pumps, in order to access the groundwater. The level of groundwater table is about 7 to 8 feet in land located in low lying areas, whereas the level is about 35 to 40 feet in general. The villagers mention that the water table level has gone down over the last couple of decades due to decrease in rainfall and also increase in number of tube-wells and submersibles.

4.1. The demise of village level CPR institutions

As in the case of Sultanpur, Johads or ponds are the main sources of surface water in Jhanjhrola Khera. In total, there are three ponds and they are named as follows – Itta waali, Pach-peer waala and Chabeli waala. Although these ponds still exist, like Sultanpur, their utility is highly reduced as they are not taken care of. The village waste water flows in some of the above mentioned Johads making them very unusable. Several

interviews revealed the existence of community level institutions in the past which looked after the maintenance of Johads. However, with passage of time, these institutions were eroded. Earlier, for every marriage ceremony in the village, a proportion of money from the bride and bride groom's side was contributed towards taking care of the village temple, Johad and the local cow shed. However, now the monetary contribution is limited to the maintenance of the temple and cow shed. Similarly, there was a time when people used to remove soil from the Johad as part of a religious practice. This practice of de-siltation helped in maintaining the Johad.

4.2. Narratives on climate change and CPRs

Prevailing narratives about climate variability and change seem to provide a justification for the neglect and demise of village level CPRs. When villagers were asked for reasons as to why Johads are no longer taken care of, they said that since the rainfall has reduced, the only source of water for the Johad is the waste water from village drains. As a result of this, it is no longer possible to maintain the village Johads. Thus, the overall picture that came up was that in the absence of a reliable water source, which used to be rainfall in the past, the impetus for villagers to care for Johads was lost. The religious practices surrounding their maintenance were either discontinued or completely forgotten. In the early stages of the project, when the team was contemplating different options for intervention and mobilising the community, the possibility of mobilising community support for reviving the johads was explored, to which the resounding response was 'jab barish hi nahin hoti, to johad ko phir se zinda kar ke kya karenge" (when there is no rain, what is the point in reviving the johad to harvest the rain-water?)

5. Differential vulnerability and adaptation to climate variability under different land tenure systems

The approach behind understanding climate change in this section of the paper was to document how people in these two villages perceive a changing climate, what its implications for agricultural practices have been and how the peri-urban residents have adapted to them. Efforts were made to understand what they considered to be the drivers of climate change. This helped in assessing their awareness of a changing climate.

5.1. Is the 'mausam' changing? Distinguishing weather from climate in the field

An important challenge encountered in all this analysis was that of methodology and language. In Hindi – the language in which the fieldwork was conducted, the words for climate and weather are the same – 'mausam'. This poses a practical challenge of how to communicate with the people what we are trying to assess. The key then was to listen to people's experience and code it at the level of our analysis, in terms of whether what they described was a persistent long term shift in the experience of mausam.

5.2. Perceptions of change in rainfall pattern and duration and intensity of seasons

Since rainfall plays an important role in the day to day life of the farming community, a change or uncertainty in rainfall pattern works as a benchmark for them to perceive a changing climate. As per the people interviewed, rains were good till the year 1977 and since then there has been a decrease in rainfall. The year 2010 has been considered to be an exception as it rained quite heavily that year.

Villagers also perceive a changing climate in the form of increase or decrease in intensity as well as duration of winter and summer season. In general, villagers said that the winter season has reduced in terms of intensity as well as duration. Now, winter seasons are confined to only two months of December and January, unlike earlier when winter season spanned over four to five months. Besides, people also perceive a changing climate through changes in cropping pattern. Especially for farmers, their association with increase/decrease in intensity of seasons is not in terms of temperature – as is the common yardstick for assessing climate change at the global level - but in terms of increase/decrease in number of summer/winter/rainy months and its corresponding impact on their cropping choices.

Reduction in intensity of winter has been perceived by villagers in a very interesting manner. A few mention that there was a time when a pot of water kept out in the open in the winters would freeze overnight. However, this does not happen anymore. Another interesting way of perceiving climate change by villagers is to mark a specific year or a particular decade and say that the climatic parameters have not been stable since then. As noted above, this is the case with rainfall, where people keep 1977 as the benchmark year. For the seasons, the 1980s is considered to be the period till which seasons were timely. In fact, winter season and fogs were considered to be more prevalent and consistent till the 1980s.

5.3. Differential vulnerability under different systems of land tenure

Understanding vulnerability and identifying vulnerable groups requires us to understand the location of farmers in different systems of land tenure.

In both the villages, there are different land tenure systems such as Kann, Peshagi and Adh-batai. Under the system of Kann, the farmer who takes the land pays back the land owner in terms of a portion of the produce. The transactions under Kann are mainly in the form of specified Kilograms of wheat and the same amount of fodder. Repeated interviews with farmers indicate that about 560 Kg. of the produce and fodder each are to be given to the land owner for every acre of land taken on Kann. Since the mode of payment is in terms of produce, it is done after the crops have been harvested.

Under Peshagi, the tenant pays a fixed amount of money per acre of land to the landowner even before he starts cultivating the land. The land rate under this system is in the range of Rs5,000 to 6,000 per acre. In the event of crop failure, he ends up losing the produce and is also at loss as he has already paid rent to the owner of land. Tenants who take the land on peshagi would thus tend to be quite vulnerable to the effects of an uncertain climate. Under Adh-batai, the owner and cultivator of land equally share the inputs required for growing a crop. Once the produce is ready, it is equally shared between them (See table 3 for distinguishing features of these systems of land tenure)

Table 3: Land tenure systems

Type of Land Tenure System	Stage of payment or sharing outputs	Mode of Payment	Scale of Vulnerability for tenant or owner
Kann	After harvesting	Grain and Fodder	Moderate to high for tenant
Peshagi	Before harvesting	Money	Very high for tenant
Adh-batai	After harvesting	Equal sharing of either crop or money	Neutral or equal for both owner and tenant

Source: Field notes-2011

Further insights about the different land tenure systems are presented as follows –

Kann – High level of trust and kinship is observed under this system and it is practiced among farmers from the same or adjacent villages. Geographically this type of tenure system is not spread out; this enables easier transfer of produce and fodder. Among the three land tenure systems, this is the most prevalent.

Peshagi – This is observed mainly among farmers who have sold their land and in return, have purchased land in another district or state. In such a scenario, they prefer payment to be done in the form of money. Geographically, this is a more spread out land tenure system. This is also observed among farmers who have moved to cities but still want to maintain their hold on the agricultural assets in the village; this is done by giving out their land on Peshagi.

It is important to note that with urbanization, the system of Peshagi has become more prevalent in peri-urban villages as it allows the migrating urban elite to maintain a hold on their rural assets. As noted above, it is also a system of land tenure under which the tenants are very vulnerable to the effects of an uncertain climate.

Adh-batai – This requires very close understanding and kinship among two farmers. It is generally observed within the village. Among the three systems, this is practised the least. The onset of urbanization has also led to demise of this form of land tenure system, as farmers prefer to give their land on Peshagi. Although Adh-batai sounds like a safe bet, it is almost non-existent in the village. Farmers speak about conflicts that may happen in terms of sharing the cropping inputs as well as the final harvest. A more hassle free way of land tenure system is always preferred.

Although above mentioned land tenure systems sound simple and smooth in functioning, they are not the same if looked at from a vulnerability perspective. A tenant, under Peshagi, makes an advance payment for the crops that he will grow in future on the land. If for some reason such as erratic rainfall, flood or a dry season he is not able to grow any crops, he is at a loss as he has already made the payment. Similarly, under Kann the landowner demands for a specific portion of the produce, irrespective of what the tenant could grow. This again gives rise to the scenario of either profit or loss for the tenant. In case the crop gets completely destroyed, the tenant is sometimes freed from the obligation of making any payments to the landowner. However, most of the times, the tenant is asked to cultivate the land in the next season and pay back the landowner. The tenant is still at a loss as he loses the money he invested in the cultivation process.

5.4. Adaptive responses to climate variability under the land tenure systems

The location of farmers in different systems of land tenure not only shapes the degree of their vulnerability to an erratic rainfall regime, but also influences their cropping choices. Under the system of Kann, the tenant is forced to grow wheat, since the mode of payment is in the form of wheat and fodder. This limits his choice of crops. However, since wheat cultivation is relatively water intensive, the tenant becomes vulnerable to uncertainty associated with rainfall and also becomes more dependent on groundwater usage. The groundwater however is saline and its use reduces the overall productivity.

Given a choice, the tenant would want to grow mustard as it requires less water compared to wheat and thus reduces his vulnerability to uncertainties associated with rainfall. Pragmatically, this aspect plays out in a very interesting manner. The tenant uses a section of the total land taken on Kann for cultivating wheat that is sufficient to pay back the landowner. The rest of the land holding is used for cultivating mustard. Choice and ability to grow a mix of wheat and mustard makes a tenant as well as landowner less vulnerable to changes or uncertainty in rainfall pattern. Since a tenant is already bound by the terms and conditions of the land tenure system, growing a mix of wheat and mustard acts as his adaptation strategy to mitigate the effects of vagaries associated with rainfall.

5.5. Climate variability and adaptation: Changing cropping choices in Sultanpur

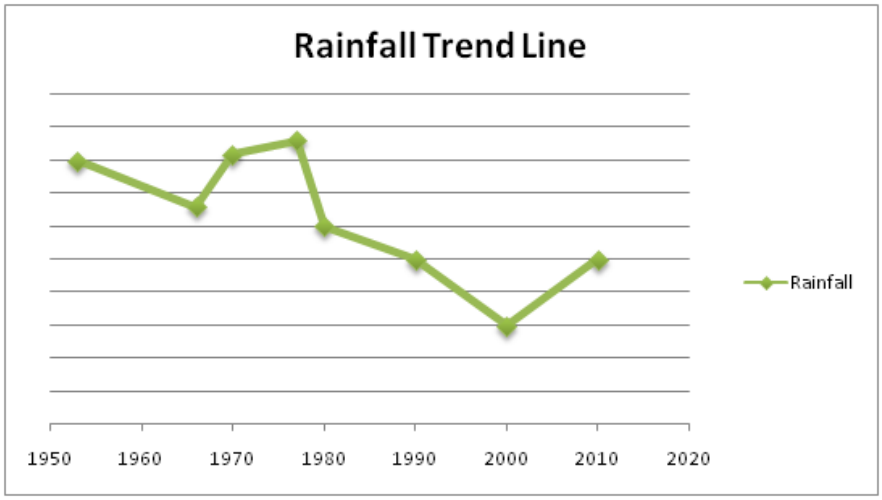
In Sultanpur, the main crops grown during Rabi season are wheat and mustard and during Kharif season are sorghum and pearl millet. However, on account of saline groundwater and reduced rainfall since 1977, farmers now grow only one crop yearly. Also, if they grow a Kharif crop, then the productivity of crops grown in Rabi season of the same cropping year reduces.

Considering the cropping pattern from a historical perspective, about 10 to 12 years ago farmers used to grow vegetables and flowers. Now, very few farmers are able to grow them. About 25 to 30 years ago farmers also used to grow pulses on their fields. However, pulses are not grown anymore. Reduction in rainfall was cited as the main reason behind such changes in cropping patterns.

The impact of decreased rainfall on crops was captured while interviewing a villager. He said that due to less rainfall and resulting dryness of land, termites easily move to top soil and harm the crops. That is, a decline in moisture increases the presence of termites in the field and harms the crops.

The year 1977 is constantly referred to by the people as the benchmark year for comparing the volume of rainfall across decades. Participatory Rural Appraisal (PRA) exercises conducted in the village buttressed this. The rainfall trend-line provided below shows 1977 as the year of highest rainfall over the last 6 decades, spanning from 1952 to 2010.

Figure 1: Relative decadal variation in rainfall in Sultanpur(based on people's perception)



Source: Village Participatory Rural Appraisal (PRA)- 2012

Non-production of pulses is also compared with this year. With the reduction in rainfall, the production of pulses went down and eventually ceased. For some villagers, high rainfall in the year 2010 is comparable with the kind of rainfall observed in 1977. However, others believe that the rains in 2010 were only relatively better than rains in the preceding years and pitched the rainfall of the year 2010 at about one-third the level of rains in 1977.

5.6. Cropping choices and people's perception of a changing climate – Insights from Jhanjhrola Khera

In Jhanjhrola Khera, the main crops grown during Rabi season are wheat, mustard and barley, whereas the main crops grown during Kharif season are sorghum and pearl millet. Over the last 15-20 years, a change in cropping pattern is very evident in the village, as in the case of Sultanpur. Earlier farmers used to grow Pulses. However, as a response to dwindling rainfall, they started irrigating land using saline groundwater. This in turn made the agriculture land unfit for growing pulses. Villagers also used to grow many vegetables in the past. However, since the groundwater is saline, vegetables can no longer be cultivated. This was also evident from the seasonality analysis carried out in the village, as shown in table 4.

Table 4: Seasonal variation in crop selection in Jhanjhrola Khera

	Kharif Crops	**Rabi Crops**
Crops - 30 years back	Pearl millet, Gowar, Sorghum, Cholai, Dhaincha, Maize	Cucumber, Tomato, Peas, Wheat, Mustard, Chana, Potato, Fodder crops – Jai, Barsam, Kaasni
Crops - At present	Pearl millet, Gowar, Sorghum, Dhaincha,	Wheat, Peas, Mustard, Carrot, Radish, Fodder crops – Jai, Barsam, Kaasni

Source: Village Participatory Rural Appraisal (PRA) Seasonality Analysis-2011-2012

5.7. Rainfall vagaries and cropping choices

There are some farmers who grow groundnuts and onions. Interestingly, these farmers have their agricultural land in the low lying area, called 'Jheel' in local language. Excessive rainfall turns out to be a curse for them, as they are not able to grow any crop, as the low lying fields get flooded. This is what happened in the year 2010, when due to excessive rainfall, farmers could not grow main crops such as wheat and mustard. On the other hand, when the rainwater subsided, they were able to grow vegetables and legumes which are impossible to cultivate using saline groundwater. Changes in rainfall thus translate into a different menu of cropping choices for the farmers, through which they adapt to these changes.

5.8. Geographically dispersed plots of land as a cushion

From a perspective of vulnerability to the impacts of heavy rains, a farmer with all his land holdings in the low lying area would be more vulnerable as compared to a farmer with some land holdings in even terrain or with scattered land holdings, as having lands geographically scattered serves as a cushion. If some low lying lands get flooded, then the other (geographically scattered) plots of land are still available to cultivate. For instance, during the course of our fieldwork we met a farmer – who had about 10 acres of land – but the land of all of his clan was located in a low lying area; all his land had got flooded during the rains of 2010 and his crop got affected adversely. This could be contrasted with another farmer who had about 5 acres, but none in a low lying area. He was not affected by the heavy rains.

6. Land use change, increasing water claimants and peri-urban water security

While climatic variability changes water supply through changes in the frequency, intensity and duration of rainfall, further changes in water availability in peri-urban areas are triggered off by changes in land use. Land acquisition by the institutions of the state or by private bodies is an integral aspect of transformations and changes underway in peri-urban locations; multiple uses of water among multiple claimants follow suit. The sale of lands tends to widen economic disparities and further shapes differential vulnerability and adaptive strategies.

In peri-urban locations, land and water have multiple claimants and the same sources of water are put to several competing uses. For example, inside the Sultanpur National Park in the vicinity, an area of about 180 acres of land requires to be flooded with water for about five months to attract migratory birds. This water is obtained from the Gurgaon Water Supply Channel, that is the main source of water to the city of Gurgaon as well as to both these villages, and emerged as a competing claimant over local water sources since the 1980s.

The owners of farmhouses in the vicinity - an 'urban' use of the 'rural' land – also compete for local water sources. They require water to grow fruits and vegetables; to nurture their orchards and vast expansive lawns. Interestingly, during an interview with a farmer, he pointed out that farmhouse owners needed water

all year round for watering grasses, fruits and vegetables, while farmers irrigated for only four months during the year, that is, during the Rabi season. Besides, they pump water using expensive 15 hp submersible pump-sets that the locals cannot afford. There are about 40 such farmhouses on the agricultural land of Sultanpur, who compete for local water; groundwater is thus driven out of the reach of the small and marginal farmers who are unable to afford the high costs of extraction.

Land acquisition further diminishes the access of peri-urban residents to water. Farmers who sold their land or whose land was acquired, also lost their right to access water from the land since rights to water are tied to rights to land (Narain, 2009a). Besides, no additional payment/compensation was given to farmers who had installed tube-wells on their land. Since installation of tube-wells entails investment, these farmers were at a loss. So, once the land was gone, the means as well as right of accessing water was gone.

Interesting dynamics emerge when one considers acquisition/purchase of land from the perspective of kinship and social relations. It is a common practice among village farmers to be dependent on tube-wells in nearby lands for irrigating their own lands. However, if the owner of a nearby land decides to sell it, the farmer who was dependent on this water source loses access to water. Changes in water access in peri-urban contexts thus come not only from the increasing claimants over water, but also from the land acquisition process that deprives the locals of access to water sources located on those lands. Often this takes the form of loss of social capital, when access to water sources is lost as those sources are located on the lands of friends and relatives who sell their lands off.

6.1. Land acquisition/purchase in Sultanpur & Jhanjhrola Khera

Table 5 captures the land acquisition/purchase process in Sultanpur, from a historical perspective. It also captures how land rates have increased with time.

Table 5: Details of land purchase/acquisition

Purpose of land acquisition and agency	Year of acquisition/purchase	Area of land acquired/purchased (acres)	Compensation/land purchase rate (per acre)
Sultanpur National Park (Government)	1970	350	Rs. 1000 – 2000
Drain construction (Government)	1978	30 – 40	Rs. 18 Lakh[15]
Fisheries Department (Government)	1980/85	20 – 25	Rs. 8000
KMP Highway (Government)	2005-06	100	Rs. 18 Lakh
Reliance (Private)	2007-08	60 – 70	Rs. 22 Lakh
Gas Authority of Indian Limited (Government)	2009-10	2.5	Rs. 60 – 62 Lakh

Source: Village Focussed Group Discussion-2011-2012

As against Sultanpur, land acquisition and purchase is a recent phenomenon in Jhanjhrola Khera. As per the village Nambardar, no major land acquisition or purchase happened before the year 2005. In the year 2005-06, Reliance started purchasing the village land, which went on till the year 2008. The total area of land acquired by them is about 150 to 160 acres at the rate of Rs. 22 Lakh/acre. Apart from the land purchased by Reliance, the village land has also been acquired by the Government for construction of Kundli-Manesar-Palwal (KMP) highway. In return for their land, the owners received a compensation of Rs. 18,60,000/acre. The total land acquired was about 10 to 15 acres. Although Jhanjhrola Khera is yet to observe major land use changes, with the construction of KMP highway, it is perhaps on the anvil.

6.2. Changing rural-urban flows and differential adaptive capacities

Peri-urban and urban flows of goods, services and resources lead to widespread diffusion of urban values and lifestyles, which has been very evident in case of Jhanjhrola Khera and Sultanpur (Willis, n.d.). Flow of monetary capital is an integral part of the land sale/purchase process and it has directly reflected itself in the form of lifestyle changes for the village residents. This has been very evident since land acquisition was initiated by Reliance, both in Jhanjhrola Khera and Sultanpur. There are many pucca (concrete) houses that have either been newly built or have been renovated from the proceeds of the land sales. The number of vehicles, both two and four wheelers, has also increased. In general, the money received from selling land

has been spent on buying land elsewhere at a lower rate, building new houses and buying cars. Proximity to cities has also enabled villagers to move to cities and look for other employment options. With the inflow of money, a number of liquor shops have come up and there has been an increase in alcoholism. Villagers have also spoken about increased instances of fights and conflicts.

These processes of sale of land and fresh inflows of cash translate into wide economic disparities in peri-urban contexts; the peri-urban elite are able to gain both from rural and urban sources of economic activities and assets (Rigg, 2006; Tacoli 1992, 2002). Since peri-urban residents differ in their access to sources of income and assets, they have differential adaptive capacities as well. Those with superior access to economic resources can better deal with drinking water issues in the village, which is dealt in the following section.

7. The social construction of water insecurity; adaptive strategies and responses

Water insecurity is as much of a social construction as it is a physical one (Mehta, 2005). While land use and climate change contribute to a growing physical scarcity of water, the effects of this are further compounded at the village level through a complex interplay of caste, class, gender and locational issues. Besides, illegal water connections hamper the easy distribution of water to all those who need it. We now turn our attention to aspects of water insecurity that the residents of these villages face in their day to day lives.

First, however we examine the institutional framework for water management and delivery as well as the physical infrastructure through which this takes shape. As noted earlier, the drinking water requirements for both the villages are met mainly by the supplied water provided by PHED. This is a canal based water supply. The PHED has taken a water connection from the Gurgaon Water Supply (GWS) channel, a channel that carries surface water to a water treatment plant in Basai, a village close to Gurgaon. Water treated from this plant is distributed among different residential sectors in Gurgaon city. This GWS channel was built by the Irrigation Department. Several organizations are involved in this water nexus. Water in the channel is owned by the Irrigation Department. Haryana Urban Development Authority (HUDA) purchases this water from the Irrigation Department and supplies it to different sectors in Gurgaon city. PHED purchases the canal water from HUDA in order to meet the water demands of villages.

7.1. Distribution of supplied water and related issues in Sultanpur

As noted earlier in the paper, the water supplied by the PHED is available only in the section of the village between Gurgaon-Farrukhnagar highway and the rail route. Water is first taken from the GWS channel and then it is transferred to a water treatment plant in Iqbalpur. Once the water has been treated, it is pumped to an overhead tank. From the overhead tank the water is supplied to Sultanpur village. In the village, water is first stored in a reservoir. From this reservoir, water is pumped using a booster pumping point. From the booster point, the water is first pumped to a common point in the village where there are several valves. These valves are opened one after the other to ensure that water is provided in all seven main pipelines for equal time. However, water cannot be provided in all the seven pipelines daily. This is because of the limited capacity of the water reservoir. Thus, water is supplied to only three main pipelines on a given day, followed by supplying water in remaining four pipelines on the next day. Essentially, this takes the form of a rationing of water in keeping with the capacity of the reservoir.

The alternate day supply schedule, combined with the erratic supply of electricity, undulating terrain, illegal and multiple water connections & excessive usage and waste of water, make it difficult for many households to access water. In addition to this, for lower caste households beyond the railway line, a caste bias also comes into play, making it an important factor shaping local water insecurity. Households in this section of the village are dependent primarily on groundwater because there are no PHED water connections beyond the rail route. Though households of elite castes and other economically well-off households can access groundwater using personal tube-wells and hand pumps, other households are dependent solely on hand pumps. These hand pumps are not community hand pumps, but have been installed by people in their private plots. So, one could lose access to this water source if the owner wanted to deny them access. Day to day dynamics, power and politics often interrupt water supply. For instance, the previous Sarpanch had installed a community hand pump. However, once he lost the village Panchayat elections, he removed the handle of the hand-pump as a sign of protest and angst.

There are several forms in which caste discrimination manifests itself in accessing drinking water. If a lower caste woman is ahead in the queue and fills water from the hand pump, then a higher caste woman, who is behind her, would first clean up the whole place and only then fill water. This increases the time spent by lower caste households in fetching water as they are solely dependent on these hand pumps. There are also instances when the common hand pump is out of order; in such cases lower caste women must knock the doors of the elite castes in order to get water. In such cases also there are signs of caste discrimination. The

lower caste women are not allowed to take their utensils inside the houses of the upper caste. The elite caste member fills water in his/her utensil and then transfers it into the utensils of these lower caste women. Another interesting insight that emerged was that the lower caste members do not have access to the community hand pump on the other side of the village. This hand pump is meant only for the village upper castes to fetch water. There also are instances when women fight among themselves when standing in the queue. Sometimes, the pots get broken as a result of these fights. Interaction with several lower caste women in this section of village confirmed existence of such discrimination.

7.2. Distribution of supplied water and water insecurity in Jhanjhrola Khera

Distribution of water is currently undergoing change in this village. PHED has recently built a water booster point in Khera. A reservoir with a diameter of 18 feet and depth of 12 feet has been constructed here, having a total capacity of 1.6 Lakh Litres. Initially water will be stored in the reservoir and then it will be pumped to different parts of the village. Thus, the distribution system will become similar to the one currently followed in Sultanpur.

The village receives its share of water supply for about an hour in the morning. Although the supplied water is expected to come every day, villagers find the supply pattern to be very erratic. Apart from the erratic nature of water supply, a very basic issue surrounding water supply is its unequal distribution and poor quality. The reasons for unequal distribution of water are uneven village terrain, illegal and faulty water connections & misuse and wastage of supplied water. As per the villagers, the water is poor in quality as it is supplied to them without any treatment. However, as per PHED officials, the water is supplied to the villagers only after proper filtration. They also believe that if at all water is dirty or poor in quality it is because of faulty and leaky water connections, for which villagers themselves are responsible. Thus, there is a certain level of blame transfer that happens between the stakeholder viz. villagers and the service provider viz. PHED.

Economic status plays a direct role in shaping the water users' adaptive responses. Households which are economically well off are capable of buying water. These households do not consume the water supplied by PHED. They purchase it from private water tankers at the rate of about 3 to 5 Rs. for 10 to 12 litres of water. The existence of a booming water tanker economy in the village clearly indicates that people are not satisfied with the quality as well as quantity of water supplied by the PHED. In the absence of any platform to hold service providers accountable, the villagers end up paying a hefty amount every month toward purchase of drinking water. Marginalised communities in these peri-urban villages are however either forced to drink the water supplied by the PHED or walk long distances to fetch water from community hand pumps.

7.3. Differential water access in Jhanjhrola Khera: issues of timing and location

In Jhanjhrola Khera, undulating terrain shapes water access mainly in Jhanjhrola, as it is situated relatively on a higher ground compared to Khera. As a result of this, about 60 to 70 households in Jhanjhrola do not get water. As an adaptation response to this, many such households have installed electric motors for pulling water to their house. This adds to their monthly electricity bills. Since electricity comes on every alternate day, people also have hand pumps specialized for pulling water. Since many people do not drink the supplied water, fetching drinking water is a daily ritual for many households.

In Jhanjhrola Khera, a common hand pump located inside the premises of the village temple is one such point where women as well as men from the village have to walk down in order to fetch drinking water. The one way distance of this hand pump, for some households, is as high as about 500 to 600 metres.

Accessing supplied water gives rise to conflicts. First of all, the access to supplied water itself is uncertain due to its erratic nature. Even when it is available, the limited availability and apprehensions of water supply ceasing create stress. A lady complained that the time of sending kids to school coincides with the time when the supplied water is available. In such a case, she gets frustrated as she is not able to make her child eat properly because water has to be collected. Further interaction with village women revealed that none of the young male adults are getting married because girls are not ready to come to a village where there is no water.

7.4. The feminization of agriculture and increasing work-load for women

Changing rural-urban links and occupational diversification also have led to changes in the gender-based division of labour and created greater feminization of agriculture. Although Rajput is a caste in which the lady of the household does not fetch water; this seems to be changing with time. One of the interviewees said that he went for work and got back only by late in the evening; his wife was not left with any option but

to fetch water by herself otherwise she would have to remain thirsty all through the day! He also commented, 'Parda paat gaya hai', (the veil has been removed), which, in the given context, meant that the traditional obligations on women for not fetching water did not hold good anymore. Thus, a change in lifestyle and occupational diversification has driven women from even higher castes to collect water. Women from higher and other castes have also been observed collecting remains of mustard crops - used as firewood. Also, women work in agriculture fields as their husbands are away working in companies in Gurgaon. This in turn has an impact on women's workload as they are forced to not just look after household chores but also to fetch water and firewood and spend more time working in the fields.

7.5. Socio-economic status and differential vulnerability in Sultanpur and Jhanjhrola Khera

As noted above, access to social and economic resources is an important factor shaping the adaptive responses of households. A household that is unable to afford water purification/water extraction technologies is more vulnerable compared to another household which can do so. Under the purview of water access, two different aspects surface out in both the villages. The first one is economic condition of the household. If a household is economically well off, it can employ multiple technologies to ensure easier access to water, despite the inherent problem of terrain. Another family, which is not so well off economically, may limit itself to using a hand pump instead of electric motor in order to cut down on cost incurred in purchasing as well as maintenance of a motor. Another family, for example a below poverty line family, may not be able to afford any of the technologies and ensure access to water by simply walking down to the nearest standpost. The second aspect that surfaces out is social capital. A family which has friends/relatives with easier access to water can also access water through them, unlike families which are solely on their own or ones that do not have any such friends/relatives. Again, a household that does not have such ties will be more vulnerable to the effects of water scarcity.

Although usage of electric motor ensures easier access to supplied water for households who can afford it, it also prevents many households from accessing water. Some villagers said that they are able to get supplied water when there is no electricity in the village. What happens is that when there is no electricity, households with motors are not able to use it for withdrawing water. Thus, the households situated further down the water pipeline are able to get water. Access to water for many households gets limited because of misuse of the supplied water. One major form of water misuse is when it is left running in personal plots for growing vegetables, fruits and fodder crops. This is very common in Jhanjhrola Khera.

Apart from households that can afford to purchase water (in Jhanjhrola Khera), there are other households where supplied water is consumed after filtering/purifying it. These households can afford to purify water using Reverse Osmosis (RO) systems and manual filters. Those households who cannot afford these expensive technologies either boil the water or use cloth as a crude filtering media while filling their pots.

Conclusion

This paper has demonstrated the different dimensions of water insecurity in two peri-urban villages. Urbanization processes trigger off several changes that affect the water access of peri-urban residents. These come about mainly through land use change, sale and acquisition of lands, rural-urban transformations and occupational diversification. These villages have seen land use change and climatic variability, both of which have shaped the water insecurity of the peri-urban residents in a multitude of ways. The impacts of the physical scarcity of water are further aggravated at the village level by the intersection of several factors such as caste, class, gender and location. The paper shows how the adaptive responses are shaped by a host of socio-economic factors such as the economic status of the households and their access to social capital.

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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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Coordinating Institution:

The project is being coordinated by **SaciWATERs**, Hyderabad, India. SaciWATERs focuses on transforming water resources knowledge systems, key ideas being an interdisciplinary approach to understanding water resources issues, from a pro-poor, human development perspective, with an emphasis on exchange, interaction and collaboration at South Asia level.

Partner Institutions:

Bangladesh University of Engineering and Technology (BUET) is the oldest and leading university in Bangladesh in the area of technology. IWFM is a premier institute for the advancement of knowledge and development of human resources in water and flood management.

Nepal Engineering College (NEC) was established in 1994, as a non-profit organization under private sector initiative, to function as center for advanced learning in engineering and allied sciences. It has been offering the Interdisciplinary Water Resources Management (IWRM) Program since the beginning July, 2007 under the support of Crossing Boundaries (CB) Project funded by Government of the Netherlands.

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