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Whose land? Whose water? Water rights, equity and justice in a peri-urban context

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Abstract:

Based on research in peri-urban areas, this paper explores questions of water justice in the context of emerging global cities. With the growth of large cities, authorities focus on meeting their water needs through infrastructure expansion and supply augmentation. The changing water needs and priorities of peri-urban locations - that provide land and water for urban expansion - receive scant attention. This paper looks at changing patterns of water use between rural and urban uses, based on research in peri-urban Gurgaon, an emerging outsourcing and recreation hub of North West India. It describes the diversity of ways in which peri-urban residents lose access to water as the city expands. These processes raise important questions about water justice, about the politics of urban expansion, and the implicit biases about whom these cities are meant for.

Keywords: peri-urban areas; livelihoods; India; water technology; water rights; justice.

Introduction

Water scholars have increasingly given attention to issues of water justice and equity in recent years (Tisdell 2003; Bakker 2001; Boelens, Davila and Menchu 1998; Debanne and Keil 2004; Giordano and Wolf 2001). Questions are raised about the conceptualization of equity (Boelens, Davila and Menchu 1998) as well as of the scale at which water equity merits consideration in the analysis of water governance (Debanne and Keil 2004). Issues of water justice have been explored in agrarian contexts (for instance, Boelens, Davila and Menchu 1998), in urban contexts (Debanne and Keil 2004; Bakker 2001) or at the transboundary or regional level (Giordano and Wolf 2001). Little attention has been paid to issues of equity and social justice in periurban contexts, with a specific focus on how the nature of periurban transformations shapes access to water and raises new questions about water justice. Though scholars in South Asia have been interested in changing water use in peri-urban contexts and its implications for conflicts, agricultural water management and inter-sectoral water allocation, too little attention has been paid to its access and justice implications, Janakarajan's (2008) work being a notable exception.

Focusing on research in peri-urban Gurgaon, an emerging residential and outsourcing hub of North-West India, this paper bridges this gap by examining water access and equity from a peri-urban perspective. Peri-urban zones are areas of transition, largely shaped by changing land use, which steadily alters water use patterns as well.

Focusing on peri-urban areas for the study of water raises important questions about equity and justice, as it demonstrates how some (groups of) people gain improved access to water, while others are deprived of it as a consequence: the augmentation of "urban" water supply often takes place at the expense of "rural" or "peri-urban" areas. Moreover, some (groups of) people in rural or peri-urban areas are better positioned than others to (re-)create, maintain, or even improve access to water or derive other benefits from resources (e.g. by selling land and the right to access groundwater) or new economic opportunities (e.g. employment). In addition, important water quality issues are involved both for groundwater and surface water sources.

This paper focuses on the important spatial dimension of peri-urban water problems, primarily in the sense that flows of water involved in them cross the boundaries of discrete spatial units defined as "urban", "rural" or "peri-urban", with important consequences for land and water rights and access.[1] Urban planners focus on developing urban infrastructure like water services, roads and highways, and improving connectivity to other cities. However, most of this expansion takes place at the expense of peripheral areas by engulfing their land and water resources. Issues of space, scale and place are thus important in understanding urbanization from a perspective of both sustainability and equity. Therefore this paper makes a case for breaking the existing dichotomic mode of thinking in terms of urban planning and rural development, and for better recognizing the flows of water resources between the "rural" and the "urban".

This paper is organized as follows. The next section provides a conceptual groundwork for the study of peri-urban issues. The conceptual connotations of the term "peri-urban" are discussed, as well as its implications for the study of water justice presented. This is followed by a discussion of the context, design and methodology of the research. Changing water use and access in Sadhraana, the first of two villages studied, is then described, followed by a discussion of water access and justice issues in Budheda, the second village. The concluding section highlights the contributions of the research to debates about equity and urbanization in general, and water justice in particular.

Conceptualizing the peri-urban: where the rural meets the urban

Rapid urban expansion in many nations proceeds concomitantly with the growth of peri-urban areas that have elements of both urban and rural characteristics and present new challenges to urban growth management (Tacoli 2006). More research and theorizing is needed on these areas of transition between the rural and the urban, presenting features of both.

Though there is no consensus on the definition of "peri-urban", the word is generally used to denote a place, a concept or a process (Narain and Nischal 2007). As a place, it refers to rural fringe areas surrounding cities. These are locations around large cities that bear the brunt of urban expansion by providing the land and water resources needed for this, while receiving urban wastes like wastewater. Brook *et al.* (2003), however, note that peri-urban is perhaps best understood as a process, representing a transition between rural and urban, and the flows of goods and services between villages and urban centers. More broadly, it could be understood as a concept used to refer to an interface of three systems, namely, the agricultural system, the urban system and the natural resource system (Allen 2003).

With the advent of urbanization, peri-urban areas grow in importance as they perform different functions for several people (Douglas 2006). Land use changes steadily from agriculture to real estate, nature conservation, mining and industry. Hence peri-urban locations become "contested spaces" (Douglas 2006: 20). Different actors bring to the urbanization processes their own interests and agendas, and city spaces end up catering to those in power. This presence of multiple competing interests exerts enormous stress on natural resources like water. Water gradually moves out from rural uses like agriculture to urban uses, including domestic use, recreation or industry. However, the links of such processes of transformation of water resources to questions of (in-)justice are not self-evident and unproblematic, as Walker (2009) rightly remarks. Mere patterns of spatial-distributional difference and even inequality do not automatically become issues of (in-)justice, if it is not clear how such differences matter for specific groups of people and in what ways injustices are produced.

An analysis of issues of water justice in peri-urban contexts would, therefore, have to throw light on the kind of questions raised by Walker (2009): in what ways do newly produced socio-environmental inequalities matter for poor resource-dependent people in peri-urban areas, and how are new injustices produced and existing ones reproduced in these processes? Answering these questions requires clearly revealing the flows of goods and services between rural and urban areas and how they are transformed in the process of urbanization, while also shaping these processes. These flows can be physical - such as the diversion of water from rural areas through canals or water tankers over long distances to augment urban water supply - or they may represent the local appropriation of rural water by the urban elite, using expensive technologies to dig deeply into the aquifers.

The links between land tenure and water security are crucial in understanding these flows and processes. Much urban expansion takes place by acquiring land in peripheral villages. Since access to water is often tied to landownership, land acquisition implies a loss of access to water sources located on them. Particularly in the Indian context, groundwater depletion is now considered an important challenge with far-reaching consequences for food security, especially in North-West India, raising questions about equity and sustainability. A common argument in the groundwater management literature in India is the pre-emption of the resource by the rural elite (Shah 1993, Narain 1998, Dubash 2002, Prakash 2005). This research shows that in current processes of urbanization around Gurgaon rural resources are pre-empted by the urban elite, who acquire the best land and, by corollary, also the groundwater of the villages at the periphery of large cities. Their access to capital resources enables them to appropriate natural resources like land and water. This, in turn, places these resources out of the reach of the poorer farmers, raising fundamental questions about equity and water justice.

Research design and methodology

This research is located in Sadhraana and Budheda, two villages in peri-urban Gurgaon. Gurgaon, located in the North-Western Indian state of Haryana, has recently emerged as a major residential and outsourcing hub. This is because of its proximity to the national capital New Delhi, and in particular the international airport and is also the result of several policy initiatives to invite industries into the city (Narain 2009a,b). These initiatives have transformed Gurgaon from a sleepy village to what urban planners and politicians call a “millennium city”. It houses the headquarters of several international corporate giants, several high-rise residential buildings for gated communities and modern shopping and recreation centers. This process has been sustained

by the acquisition of land and water from peripheral villages. Seen as unfair and non-participatory by those affected by it, is known to have fumed discord and protest among those whose land and water are acquired by the state (Narain 2009a,b).

These two villages are located about 15 kms away from the city of Gurgaon on the road linking Gurgaon with Farookhnagar. Sadhraana has a population of 3,500 people comprising 425 households. The population of Budheda is about 5,500, counting approximately 725 families. Both villages are socially heterogeneous; the livelihoods are predominantly agricultural, but face new threats from land acquisition and diminishing access to irrigation sources.

Wheat, mustard, sorghum and peas are the main *rabi*[2] crops in both these villages. Pearl-millet is a predominant *kharif* crop along with gourds, lentils and fodder crops. There is no cultivation of paddy or sugarcane. In years of good rainfall some farmers grow fruits and vegetables like musk melon, gourds, and soya.

The villages are not served by irrigation canals. Submersible pumpsets are the predominant source of irrigation. With a growing number of claimants over water and an increase of competing uses, water tables have fallen steeply. The effects of growing competition are aggravated by changes in rainfall patterns in recent decades. There has been a decline in the intensity and frequency of rains after 1977, when the state witnessed high rainfall and rainfall flooding, that affected Budheda village.

The two villages were chosen to focus on the different dimensions of water justice embodied in different types of rural-urban water flows. The first one represents the local appropriation of groundwater by the urban elite, using expensive technologies that many of the original

inhabitants of the area cannot afford. The latter represents the ecological footprint that urban expansion leaves on peri-urban locations by appropriating land and water to augment urban water supply, while discharging urban wastewater, which is widely used in agriculture but with adverse health consequences. Both represent different ways in which water justice issues manifest themselves in peri-urban contexts. A qualitative research design was employed, using a mix of semi-structured interviews with peri-urban residents, meetings with key informants, group discussions and participant observation.

Sadhraana Village

Land acquisition: multiple claimants over scarce resources

In recent decades the village has seen a gradual change in land use, as land was taken out of agriculture for other uses. Of the net cultivated area of about 1,280 acres[3] recorded in the 1960s, about 80 acres were acquired for the Sultanpur National Park[4] in the late 1960s, 600 acres have been sold off by individual residents for farm-houses[5], and 150 acres have been acquired for the Reliance SEZ (Special Economic Zone). Gradually, the village's groundwater and land resources have been appropriated by the urban elite.

There are two types of land: land overlying *khara* or saline groundwater and land overlying *meetha* or fresh groundwater. The land on the *laldora* (settlement) side of the village is underlain by fresh groundwater but on the side of the Sultanpur National Park it is saline. In the 1980s, the residents of this village, in need of instant cash, started selling their land to property dealers for the development of farm-houses. It was not only the so-called village elite that sold land, but also small landowners and plot-holders. For many it was an act of desperation as they needed cash in

times of emergency; for others because their land was no longer cultivable as the rainfall pattern changed.

Most of the farm-houses have been built on land overlying fresh groundwater. Where farm-houses have been built on land overlying saline groundwater, the farm-house owners have bought small tracts of land in the region overlying fresh groundwater to install submersible pumpsets on those plots of land and transport the water to their farm-houses - often three to four kilometres away - through underground pipes. This is the outcome of a legal and institutional framework in which access to groundwater is tied to landownership. As per the Land Acquisition Act of 1884, The Easement Act of 1882 and the Transfer of Property Act of 1882, groundwater is viewed as a chattel attached to land. In other words, access to groundwater rests with the owner of the land above it, and changes with a change in the ownership of land overlying it (Saleth 1996, Narain 1998). Hence, if one wishes to access groundwater, one must acquire the land over it. Conversely, by selling off a piece of land, one loses rights to access the groundwater below it.[6]

The owners of these farm-houses employ submersible pumpsets with a capacity of 15 hp (horse-power) to dig deeply into the aquifers, placing the resource out of the reach of most local residents who are unable to afford the high costs of extraction. The former are at an advantage in terms of tapping the village's groundwater resources, since they have financial resources that allow them to exploit the aquifers. Besides - a point that surfaced quite often in the field interviews - the pumpsets in the farm-houses run for 24 hours a day and can even run when there is no electricity supply, as they are supported by generators. Most of the residents, however, depend on electricity to operate their tubewells. As electricity is only available on alternate days they are at a disadvantage.

The farm-houses owners use the water for irrigating their expansive lawns and fruit orchards. While discussing how water use patterns varied between the farmers and the owners of farm-houses, the former said that owners of farm-houses irrigated throughout the year, while they irrigated only for four months (during the *rabi* season) to cultivate wheat and mustard. There are about 40 farm-houses in the vicinity of the village, and many more keep coming up. Their owners comprise distinguished members of the urban elite like former bureaucrats, politicians and parliamentarians, and their relatives. Most of them do not live in the village but employ attendants - often cheap migrant laborers - to look after the farm-houses. On account of their position and power they are able to evade regulatory restrictions over groundwater as well.[7]

Tubewells were also dug by the State Forest Department in the 1980s to release water into the Sultanpur National Park.[8] With the increasing number of claimants over the village's groundwater resources, the number of water extraction mechanisms (WEMs) increased from 20 about 20 years ago to about 300 at present.[9] Local inhabitants also persistently report a downward trend in rainfall after 1977 (2010 was an exception, with relatively high rainfall).

As a result, the water table level has fallen steeply and the groundwater now being accessed is saline. The fall in the water table level has been particularly pronounced over the last decade and a half. In the village it varies from 60 feet to 100 feet. Where it is 60 feet nowadays, it used to be 25-30 a decade ago. In other places, it has fallen from about 60 feet to 100 feet over the same period. The residents of the Sadhraana *dhaani*,[10] located about two kilometres from the main village, reported a fall in the water table as follows:

INSERT TABLE 1 HERE!

The peri-urban residents of the village are now forced to access saline groundwater unfit for their crops. This also harms the livestock when they consume it.[11] "Our animals are dying because of drinking this contaminated water", was often heard in field interviews.

The fall in the water table level has particularly strong equity implications, as the many economically weak and resource-poor farmers are not able to exploit the aquifers and have been forced to leave their land fallow. One of the interviewed farmers had not cultivated his land for the last twenty years. In fact, he had not irrigated ever since his *rainth* had gone out of operation.[12] A small tract of land adjacent to his own had been acquired by the owner of a farm-house for installing a submersible pumpset to transport water to his farm-house about three kilometres away.

Responses to growing water scarcity

The above analysis shows how the number of claimants over scarce resources is steadily increasing in peri-urban areas. Farmers have responded to this fall in the water table in a number of ways: a switch in water extraction technologies; the use of sprinkler systems; leaving part of their land fallow; reducing their cropping intensity by growing only one irrigated crop per year; or mobilizing social relationships.

A switch to alternative water extraction technologies: the use of submersible pumpsets

The most prominent response of farmers has been a switch to more powerful water extraction technologies, from from *lao chedas*[13], *rainth*, and tubewells to submersible pumpsets. *Lao chedas* were used till the 1950s, *rainth* during the 1960s, diesel operated tubewells were used starting from the 1980s, and submersible pumpsets have been in use since about 2005, when the water

table levels had fallen well below the reach of tubewells or diesel powered pumpsets. Till about ten years ago, farmers used *maidani* boring (surface extraction); tubewells with 3hp or 5hp pumps were in use. They have now switched from motor pumps of 3hp or 5hp to submersible pumpsets of about 7.5 hp.

The use of sprinkler irrigation systems

The increased use of sprinkler sets is also partly a response to water scarcity. Sprinkler sets have been in use here since the mid-1980s. Farmers gave three main reasons for their use: first, the terrain is undulating and sandy, making it difficult to flood the fields. Second, as the water table has become lower, it has become more important to apply water more efficiently. Third, sprinklers, whose use is automated, are less labor-intensive. As farmers diversify occupationally[14] - an important characteristic of peri-urban areas - they have less time available to spend on the fields. This requires less labor-intensive irrigation technologies.[15] Sprinkler irrigation is thus used widely. Nevertheless, a major constraint is the erratic availability of electricity - only on alternate days. This situation has worsened in recent years, electricity being increasingly diverted to meet the requirements of the growing city.

Leaving land fallow

Installing a submersible pumpset costs between Rs 100,000[16] and 125,000. This is the cost of the submersible pump-set and the labour charges for installing it. The rising cost of extraction has placed the resource out of the reach of economically weak farmers; unable to access water, they are forced to leave their land fallow. One farmer interviewed had not cultivated his land for eight years, and another for twenty years. Yet another farmer said that he had been able to irrigate until

the water table level was 150 feet; he irrigated with an electric motor of 5hp and later installed a motor of 7hp. Farmers are now using submersible pumpsets to extract water from a depth of 350 feet where his land was located, and he was unable to afford that. Thus people differ in their coping capacity to deal with the falling water tables and the rising costs of extraction. Water deprivation is more pronounced for some than for others. Existing patterns of inequality get further reproduced through changes brought on by urbanization.

Irrigating only part of the land

Another farmer response is to cultivate part of their land. For instance, one farmer interviewed cultivated only about two acres out of a total of about 12 acres. Some farmers also decide to cultivate only one crop per year.

A switch to rainfed farming

The effects of the falling water table have been further aggravated by changes in rainfall patterns. With the fall in water tables, many farmers who cannot afford new investments have had to completely cease the operation of their tubewells and switch to rainfed crops; they grow only pearl millet in the *kharif* season. However, since there has been a decline in rainfall after 1977, their rainfed *kharif* harvest has suffered. Urbanization and climate variability thus act as multiple stresses impacting the water security of the poor.

Purchase of groundwater as supplemental irrigation

Another response to water scarcity - particularly among farmers who cannot afford to install submersible pumpsets themselves - is to buy groundwater, though this is rather uncommon. This

is practiced by only a few farmers, predominantly upper-caste farmers who can buy water through their networks or social relationships. Here, again we notice the differential coping capacities of water users, showing differentiation in access to groundwater There is wide variation in the rate at which groundwater is sold, depending largely on social relations. The practice, then, is to irrigate part of the land through the farmers' own source and the balance through the groundwater that is bought.

The use of rural wastewater

Domestic wastewater that flows through one of the village drains is sometimes also used for irrigation. It is diluted by mixing it with a little “fresh” groundwater. However, the use of this wastewater is sometimes a cause of conflict between farmers, as it disrupts the flow of this water to a village pond.

Social relationships as institutions: no longer available

Both socially and institutionally, peri-urban areas are in constant transformation (Allen 2003, Narain and Nischal 2007). Urbanization and land use change can weaken the capacity of the economically poor farmers to deal with water insecurity. Often the social relationships and networks that people used to rely on for access to natural resources such as water no longer exist in peri-urban contexts. Many water users who once depended on the tubewells and submersible pumpsets of their relatives no longer have access to these, as the latter have sold off their land. Thus, while some benefit from the real estate boom by selling off their lands, this aggravates the water deprivation of those who depend on the water sources located on those lands. In particular, many lower-caste women who obtained water from tubewells and pumpsets of the higher-caste

families can no longer do so. They now need to walk longer distances in search of other sources of water, constituting an additional drudgery to their workload, which is already increasing because of diminishing access to fodder, timber and fuel wood with the increasing takeover of village lands. “Earlier we could pick up fodder and fuel wood from the land nearby, now it has all been fenced off”, was often heard in the field.

Budedha Village

Land acquisition and land use change in Budheda

Over the years, there has been a process of land acquisition in the village, whereby land has been diverted away from agricultural purposes, largely to meet the requirements of the growing city. The major land use changes in the village have been for building a dental hospital and a training college, for constructing farm-houses, and for an SEZ to be developed by the corporate giant Reliance. Besides, and perhaps most importantly, the village is marked by the ecological foot-print[17] of the growth of Gurgaon city, because it is providing drinking water to it. In particular, village land was acquired for a water treatment plant to be built at Chandu[18] Budheda, and for building a canal to supply water to the water treatment plant at the village of Basai - which is the main source of water supply to the residents of the city of Gurgaon.

At the time of this research, HUDA - the Haryana Urban Development Authority - had just completed the acquisition of about 129 acres of private agricultural land for building a water treatment plant at Chandu-Budheda to supply water to the city; another 30 acres were acquired in a second round of acquisitions. Besides, 12 acres comprising grazing land under the jurisdiction

of the village *Panchayat* were acquired for the same plant. The basis of these acquisitions is the Land Acquisition Act of 1894 that allows the state to acquire land for a public purpose. The state government acquired these lands at the rate of INR 22 *lakh*[19] per acre, about one-fourth of the market price of land. This is a subject of great dissent among the landowners, who resent being offered prices below the market price. This is of course an important justice issue in peri-urban contexts as well.

Worst affected by these changes are tenants and sharecroppers, who do not receive any compensation and lose opportunities to till the lands. As tenancy and sharecropping arrangements are not formally registered, there is no legal basis for claiming compensation, even if they were part of a rehabilitation policy. Land acquisition has been subject to much debate in the country. The Land Acquisition Act was under review and amendment at the time of writing this paper. A detailed discussion of these issues and a review of alternatives is provided in Narain (2009a).

The village has a large landless population dependent on livestock, which fed on the grazing lands acquired. Notable among these are the *Balmeek* community, for whom livestock is the predominant occupation. While the upper-caste farmers who reared livestock responded by cutting back on livestock population, the lower-caste livestock farmers like the *Balmeeks* have no choice but to walk longer distances to graze the cattle.

Besides, seventeen acres of land were acquired for each of the two canals passing through the village - the NCR channel and the Gurgaon water supply channel - to supply water to the Basai water treatment plant. 11.5 acres of land had been acquired earlier for building a dental college. Seventy acres of land were acquired by Reliance and about 60 acres of land have been sold voluntarily to farm-houses. The village is now left with just about one-fifth of its original net cultivated area. Since access to water is tied to landownership, once the land was acquired, the

former landowners also lost access to water sources like the tubewells located on it. In other words, villagers lost both land and water to provide water to the city.[20]

The Gurgaon water supply channel: a source of conflict and opportunity

The case of Budheda provides a good illustration of the land and water nexus in the peri-urban interface and the multiple ways in which this nexus manifests itself. It underscores the significance of appreciating rural-urban water flows. As noted above, lands were acquired from this village for the development of the Gurgaon water supply channel, which carries water to the water treatment plant at Bassai, the source of drinking water for the city. This channel passes over a distance of 3.5 kilometres through the agricultural fields of the village.[21] It is under the jurisdiction of the Delhi Water Services Division of the Irrigation Department.[22] Villagers used to make a breach in the canal to take water to the *johad* (village pond) for watering and bathing their livestock. The resulting reduction of the downstream water supply often caused confrontations with the Irrigation Department. In the end, the residents put pressure on the Irrigation Department to install an outlet from the canal to provide water for the *Johad*. A pipe outlet was thus sanctioned and installed, and the Gurgaon water supply channel became the main source of water for the pond. This is used by the residents of the village, particularly the cattle-dependent groups such as the *Balmeeks*. It is a village common property resource, and users do not pay for its use. The Gurgaon Water Supply Channel that provides water to the *johad* is also the source of water supply to the city, the Sultanpur National Park in the vicinity as well as several of the villages in the vicinity.

Besides, farmers who have fields along the Gurgaon Water Supply channel often illegally extract water by pumping it to their fields, particularly at night. This use of water for irrigation is

of course unauthorized; when caught, therefore, farmers are penalized by the Irrigation Department. Some farmers also installed tubewells along the water supply channel in order to take advantage of the increase in the water table made possible by its presence.

The government has more recently taken up the construction work for a second channel named the NCR Channel.[23] This channel also passes through the village over a distance of 3.5 kilometres, running parallel to the Gurgaon water supply channel. Land for this channel has also been acquired from the residents of Budheda. Since this channel runs parallel to the Gurgaon water supply channel, land has been acquired from the same people who had earlier lost their land for the Gurgaon water supply channel. Also, the tubewells installed by the farmers along the Gurgaon water supply channel were removed with land acquisition for the NCR channel. Needless to say, they can no longer steal water from the Gurgaon water supply channel either! These land transactions show that water supply in peri-urban settings is insecure, and also illustrate how the impact of the development of new water infrastructure tends to be borne repeatedly by the same groups of people, depending upon the location of their agricultural lands. Therefore, vulnerability and water insecurity are often constituted by the repeated onslaught of the same stressors on the same group of people. It is important to note that members of a clan usually have their lands located adjacent to each other. Thus, some clans are more vulnerable to the processes of land acquisition and the consequent loss of access to water sources. Besides, farmers who have their lands scattered at different places in the village are less vulnerable to the impacts of land acquisition, as this serves as a cushion or safety net against land acquisition at specific strategic locations. Urbanization processes thus distribute both risks and opportunities unequally (Narain 2009a).

Irrigation: implications of the peri-urban interface

As noted earlier, the village is not served by an irrigation canal. Groundwater is the main source of irrigation, and there is wide variation in the water table levels through the cultivated area.[24] Farmers use various water extraction technologies, depending on the varying depths of the water table. Near the Gurgaon water supply channel, where the water table level is relatively high, diesel-operated engines are used. In many other locations, farmers instead use submersible pumpsets. Urban wastewater from Delhi and Gurgaon is also an important source of irrigation, particularly for paddy. Sometimes farmers also use local domestic wastewater to supplement other irrigation sources.

For agricultural fields lying along the Gurgaon water supply channel, the water table level is quite high - about 32 feet - and farmers use diesel pumpsets here. With a fall in the water table levels in other parts of the village on account of increased withdrawals for farming and for the farm-houses in the vicinity, the use of submersible pumpsets has become more common in recent years.

Links with the city, however, also provide new opportunities for irrigation, made possible by the flow of urban wastewater that is emerging as an increasingly important source of irrigation in this village. Farmers who have their lands adjacent to this canal benefit from the diversity in sources of irrigation that this makes possible. There is a wastewater canal that runs from Gurgaon, called the Gurgaon-Jhajjar wastewater canal. Farmers use its water to cultivate paddy and wheat. As the village is not served by an irrigation canal and the groundwater is saline, wastewater provides an important means of expanding the cultivation choices of farmers. It enables them to take up the cultivation of paddy, which would otherwise have been impossible. This wastewater canal has only recently been built and, when this research was initiated, farmers

had taken just one harvest of paddy and were irrigating the wheat crop in the *rabi* season. Urban-rural water flows create differential opportunities for farmers, widening choices for some, the location of whose lands gives them access to more varied sources of irrigation. As noted earlier, urbanization processes distribute both risks and opportunities unequally.

The wastewater canal passes for about four kilometres through the agricultural fields of the village. The farmers who wish to use wastewater apply to the Irrigation Department. If the application is approved, they install a pipe along the brick-lined wall of the canal.[25] It is about 40 feet long and opens on the other side into the watercourse. When irrigation is not needed, the pipe is closed on both sides. On the canal side, it is closed using a jute bag, and on the watercourse side a plastic lid is used. There are about 50 to 60 such outlets along the canal. Wastewater users pay Rs. 50 per acre to the village *lumbardaar*, who deposits the dues with the *patwaari*.[26] Farmers also extract water using siphons: they pump the water using diesel pumpsets or their tractors.

Many farmers interviewed consider wastewater irrigation cost-effective. Wastewater use reduces the need for expensive chemical fertilizers, since the water is already nutrient-rich. It therefore allows the crop to mature faster; a one-month crop matures in, say, 25 days. Besides, once the pipe is installed, it removes the need for costly pumping. During wheat cultivation, farmers reported using two irrigations using wastewater. They opened the pipe for two full days to flood their fields during the *rabi* season.[27] For paddy, farmers reported using wastewater four times during the *kharif* season.

Wastewater irrigation also causes conflicts. If the pipe is left open for a longer period and the irrigating farmer forgets to seal it after irrigation, the fields get flooded and the water overflows into neighbors' fields. Many farmers reported crop damage due to negligent over-application of

wastewater. Besides, prolonged usage of wastewater for irrigation is known to have adverse effects on the health of both irrigators and consumers of the crops.[28]

Various factors contribute to the vulnerability of farmers to an unreliable water supply in peri-urban areas.[29] As noted above, when the Gurgaon water supply channel was dug - about 15 years ago - farmers with their fields adjoining the water supply channel had dug tubewells to benefit from the rise in the local water table level. However, when the land was acquired for the NCR channel that was to run parallel to the Gurgaon water supply channel, these tubewells were removed. This has increased the farmers' reliance on wastewater, which is now their only source of irrigation water.

However, variations in rainfall patterns often mean that this source of water cannot be used. The lands adjacent to the wastewater canal are in a low-lying area, and get flooded during heavy rain. In 2010, for instance, there were heavy rains and the agricultural fields along the wastewater canal remained flooded, damaging the paddy crop. Farmers could not sow the wheat crop either, as flooding extended well into the wheat-sowing season. They received no state support to drain off excess water, while urban authorities diligently drained off excess water from the nearby land where the water treatment plant was under construction. Worst affected were tenants who have to pay a pre-agreed proportion of the produce to the landowners. Many of the village elite - especially the business men - have moved to the city to take advantage of the burgeoning markets and have set up shops there. However, they maintain a hold on their village land by giving it out on tenancy arrangements. Once a tenant enters into such an agreement, he becomes bound to pay the pre-agreed proportion of the produce.

There is a second wastewater canal that passes through the village, which carries the waste of Delhi.[30] Unlike the Gurgaon Jhajjar canal, however, this is a *kutcha* (unlined) canal. It cuts across

a distance of about 3.5 kilometres through the agricultural fields of the village and exists since the 1950s. Farmers who have their fields along this canal irrigate from it as well by pumping water to their fields, either through diesel pumpsets or by tractors. Farmers irrigate wheat and paddy using this water, mainly because it is cheap and carries nutrients, since it is untreated wastewater. Besides, it is available throughout the year. Thus it serves as a cheap and perennial source of nutrient-rich water.

While this widens farmers' irrigation choices and opportunities, it also has negative effects. The area served by the canal has clayey soils. It gets spoilt by the increase in the water table level during the rains, resulting in harm to the crops. Unlike the interface with the Gurgaon Jhajjar canal described above, access to water is not controlled here. Large tracts of agricultural land remain submerged for long periods during the monsoons. Local estimates by farmers put this figure at about a third of the agricultural land of the village. The village livestock that grazes here is reported to be inflicted with allergies, parasitic infections and diarrhea. Once the farmers' fields have been irrigated with this water for about three to four years, they have become unproductive.[31] The villagers have made several requests to local authorities to address the situation, but with little impact.

Conclusion: implications for water rights, equity and justice

This paper contributes to the growing literature on water justice and equity (Debanne and Keil 2004; Giordano and Wolf 2001; Tisdell 2003; Bakker 2001) from a periurban perspective. While most studies of water justice and equity focus on predominantly agrarian or urban contexts, this research shows how the nature of periurban processes and transformations and emerging rural-urban links shapes access to water in periurban contexts, and places some individuals and

communities at a disadvantage over others. This study of Sadhraana and Budedha shows how peri-urban water use, access and management change with the expansion of cities and steady appropriation of water for urban expansion at the expense of other uses and users. Water appropriation - as represented by different types of water flows and changes in them - is shaped by a host of technological and institutional factors that favour the "urban" over the "rural" or the "peri-urban". These flows can be physical flows of water from rural to urban areas but may also involve the local appropriation of rural water for urban purposes. They also include flows of urban wastewater to the periphery, increasingly used for irrigation but also flooding peri-urban fields and damaging crops. Aside from this, consumption of wastewater-irrigated crops may have a negative health impact. Further, these flows may be directed by state intervention to support urban expansion - as in Budheda - or may take shape through the initiative of urban residents themselves, who move into the peripheries to acquire cheaper land - as in Sadhraana.

From a policy and institutional perspective, the most important factor shaping these dynamics and interactions is that water access is tied to landownership.[32] Thus, when land is acquired for urban expansion, landowners *de facto* lose access to related water sources, as noticed particularly in Budheda. There has been much debate in the Indian media on (and politicization of) land acquisition and compensation thereof, but its implications for peri-urban water security and justice have received scant attention (Narain 2009a). However, questions of land tenure, water rights, equity and justice are closely related in peri-urban contexts. Water access is shaped by access to technological and financial capital. Since the urban elites have the upper edge on this in comparison to their rural or peri-urban counterparts, they appropriate rural water resources while evading regulatory controls and restrictions. The effects are further aggravated by factors like

differential economic and occupational status and location of agricultural fields, that influence the extent to which water users are affected by urbanization.

The study of Budheda particularly highlights the multiple ways in which urbanization affects the access of peri-urban residents to land and water. Here, the development of water treatment plants to quench urban thirst takes place at the expense of fertile agricultural and pasture land. In addition, the constant expansion of urban infrastructure makes peri-urban residents dependent on an uncertain water supply, increasing their reliance on wastewater, which is cheap but has adverse long-term health effects. The effects of these processes are aggravated by changes in rainfall patterns and climatic variability, which increase water insecurity of resource-dependent inhabitants of peri-urban areas.

This increasing vulnerability of peri-urban residents is the result of a politics of urban planning that favors the pre-emption of resources to cater to the needs of industry and urban elite, with little voice for peri-urban residents themselves, whose land and water resources are engulfed to provide for the growing city. Implicit biases in planning and policy-making about what constitutes development and what or who needs to develop constitute the basis of these transfers. These biases are captured in narratives about the glory of millennium cities like Gurgaon, that seem to provide a basis for this pattern of expansion: such cities need to grow and the urban thirst needs to be quenched, even at the expense of people in the peripheral areas and their access to land and water.

Shatkin (2007) argues that much literature on urban planning has failed to consider the significance of “politics and power relations”, assuming instead that all actors have equal amounts of power at their disposal (2007: 9). As Roy (2009) rightly asserts, different interests compete with each other to make the city what they want it to be for their own survival. City

planners end up catering to the needs of those whose interests are more powerful. Planning, in essence, is a battle to assert dominance over areas of space that are negotiated and contested by many actors; in this space of contestation, peri-urban residents themselves have barely a role to play. Reversing this, and integrating peri-urban residents in decision-making process and land use planning will be essential for making urbanization processes sustainable and equitable.

Finally, and returning to issues of water justice, a comparison of the two villages - located barely three kilometres apart - shows that generalizations are difficult, and changes highly localized and context-specific. Much depends on the local context and access to various sources of water. While a peri-urban focus helps us look at these relationships and flows of water across the village and the city and thus address questions of justice, it can be dangerous to generalize on the nature of rural-urban interactions and flows without a better understanding of local specificities. It is not possible to make general judgments about whether people are better or worse off by selling their lands, how these processes relate to new opportunities created by urbanization, and from there to make statements about justice. The effects of these transformations, in combination with others, are complex, mixed and ambiguous.

However, notwithstanding these complexities, this analysis has contributed to a better understanding of peri-urban land- and water-related transformations in terms of how these processes impact on the lives of resource-dependent people, and how existing injustices are reproduced and new ones produced. What it does bring forth from a more practical perspective is that planning processes need to explicitly recognize the deep impacts of these flows of water between rural and urban areas, rather than view rural and urban water supply either as if they were distinct, unrelated domains, or as merely technical interventions for urban water resources development. In other words, the water rights and justice dimensions of these flows of water

between villages and urban centers need to be better recognized and reflected in planning for water resources management.

As cities grow, the imperatives of breaking this dichotomy between urban and rural water supply will grow stronger. A combination of locally tailored participatory and action research, community mobilization and the creation of multiple stakeholder platforms to bring together peri-urban residents, and rural and urban planning authorities will be needed to address these concerns in the future. This shall have to be the basis for designing interventions tailored to specific local contexts, which also take into account the rights and justice dimensions of these transformations.

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Notes

[1] I deliberately focus on the urban - rural / peri-urban relationships here. I am aware that intra-village equity issues are huge and show complex emergent patterns of both threats to livelihoods and exclusions, as well as new opportunities. This would, however, require a separate paper.

[2] Northwest India has two cropping seasons: *rabi* (winter season) and *kharif* (monsoon season). The *rabi* crop is harvested around April, the *kharif* crop around November.

[3] 1 acre = 0.25 hectare.

[4] The Sultanpur National Park was developed in 1972 to preserve the region's rich bird-life.

[5] These farm-houses serve as weekend and recreational getaways for the urban elite. They are used for hosting social get-togethers and parties.

[6] In practice, this is more than the groundwater strictly beneath the land. It depends on the pumping capacity, and could mean drawing water from beneath neighbouring lands.

[7] A recent norm requires registration of all new groundwater structures. In a neighbouring village, the village headman received a notification that a new tubewell was being dug by a farm-house owner. When he approached the owner, he was threatened and told that the owner "would take care of the matter".

[8] However, in 2000 the use of these tubewells was discontinued because of high fluoride content. The National Park got connected to a canal-based irrigation source, the Gurgaon Water Supply Channel, that meets the drinking water needs of most of the city.

[9] The farm-houses, right from the time they came up, extract water using submersible pumpsets. Among farmers and the peri-urban residents, the switch to submersible pumpsets was relatively recent: with the fall in water tables becoming steep, since 2005.

[10] Small hamlet or settlement located away from the main village settlement area.

[11] This salinity is on account of geological factors. At one time, salt pans were widespread near the village and constituted an important economic activity for the residents of neighbouring Sultanpur.

[12] The *rainth* is an irrigation technology operated by a bullock.

[13] Manually operated pulley.

[14] Occupational diversification also entails new opportunities for peri-urban households, even those who lose out in land- and water-related processes. This multidimensional character of the changes makes it difficult to generalize in terms of justice.

[15] Peri-urban residents regularly set their irrigation apparatus and go off to attend to other activities. Their physical presence is not required for irrigation. This promotes occupational diversification by releasing time for other economic activities, and encourages the youth to attend college while water oozes out from the sprinklers back home.

[16] At the time of this research, 50 Indian Rupees were equivalent to 1 US Dollar.

[17] Ecological footprint is a measure of the human demands on the earth's ecosystem. The concept was coined by Rees (1992).

[18] Chandu is the name of a village adjoining Budheda.

[19] One lakh is one hundred thousand.

[20] Note that land acquisitions by the state are compulsory. The price at which the state acquires land is normally between a third and a fourth below the market price (Narain 2009a).

[21] Gurgaon city presently gets water through Gurgaon Water Supply Channel, which originates from village Kakroi in district Sonepat and culminates at village Basai in Gurgaon. This channel has been recently upgraded to carry 175 cusecs instead of 100 cusecs of water earlier. An

expenditure of Rs 19.63 crores has been incurred on this to meet the drinking water demand of the growing population of Gurgaon.

[22] Its off-take point is the Delhi branch RD 22, 780RD of the Western Yamuna Canal and discharge at head is 175 cusecs. Its depth is 6.55 feet and total length is 69.385 kilometres.

[23] This work has been undertaken at a cost of Rs 225 crores; the NCR channel would have a capacity of 800 cusecs of water and a major portion of it would be for Gurgaon.

[24] The water table level is 50-100 feet in some places and 9-10 feet in some other places.

[25] One pipe usually serves about 15-20 acres of land.

[26] Both are village record keepers.

[27] This was an average number. When the water level in the parent canal is high, the discharge increases and the time required to irrigate decreases.

[28] See e.g. IWMI (2003), Feenstra *et al.* (2000) and WII/IWMI (2006).

[29] "Vulnerability" - popularized by the climate change discourse - is often used to draw attention to specific contextual factors that influence exposure and the capacity to respond to change, to explain how and why groups and individuals experience negative outbreaks from shocks and stressors (Leichenko and O'Brien, 2002). The concept captures the changing nature of risks and variable capacity to cope with risk and change (Kirby, 2006).

[30] Locally called a *gundah nullah* (Hindi: sewer).

[31] This was an important reason for some villagers to sell land to the corporate giant Reliance for development of an SEZ.

[32] Note that de-linking land rights and water rights is not a solution, as this might contribute to turning water into a free, tradable commodity.

Table 1: Fall in water table, Sadhraana *dhaani*

Year	*Water table level (in feet)*
1980	10
1990	15
2000	50
2010	80

Source: discussion with residents of Sadhraana *dhaani*