Conjunctive Water Management in Indore Based on Demand Focused End Use

Community Context Analysis

Rahul Gandhi Nagar

(Final Report)

An Initiative under ACCCRN

ACCCRN
Asian Cities Climate Change Resilience Network
SUPPORTED BY
THE ROCKEFELLER FOUNDATION

Submitted by

TARU
TARU Leading Edge
Gurgaon and Gandhinagar
India

May 2012

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Abbreviations

BGMS	Bharathiya Grameen Mahila Sangh
BIS	Bureau of Indian Standards
CCA	Community Context Analysis
CEPRD	Center for Environment Protection Research and Development
CWM	Conjunctive Water Management
DFID	Department for International Development
FGD	Focused Group Discussion
GIS	Geographical Information System
GPS	Global Positioning System
HP	Hand Pump
IDA	Indore Development Authority
IMC	Indore Municipal Corporation
LPCD	Liters Per Capita Per Day
MP	Madhya Pradesh
MPN	Most Probable Number
MPUSP	Madhya Pradesh Urban Services for the Poor
NGO	Non Governmental Organization
RCVs	Representatives of Community Volunteers
RG Nagar	Rahul Gandhi Nagar
SESI	Slum Environment and Sanitation Initiative
SHG	Self Help Groups
ULB	Urban Local Bodies
UN	United Nations

CHAPTER 1: INTRODUCTION

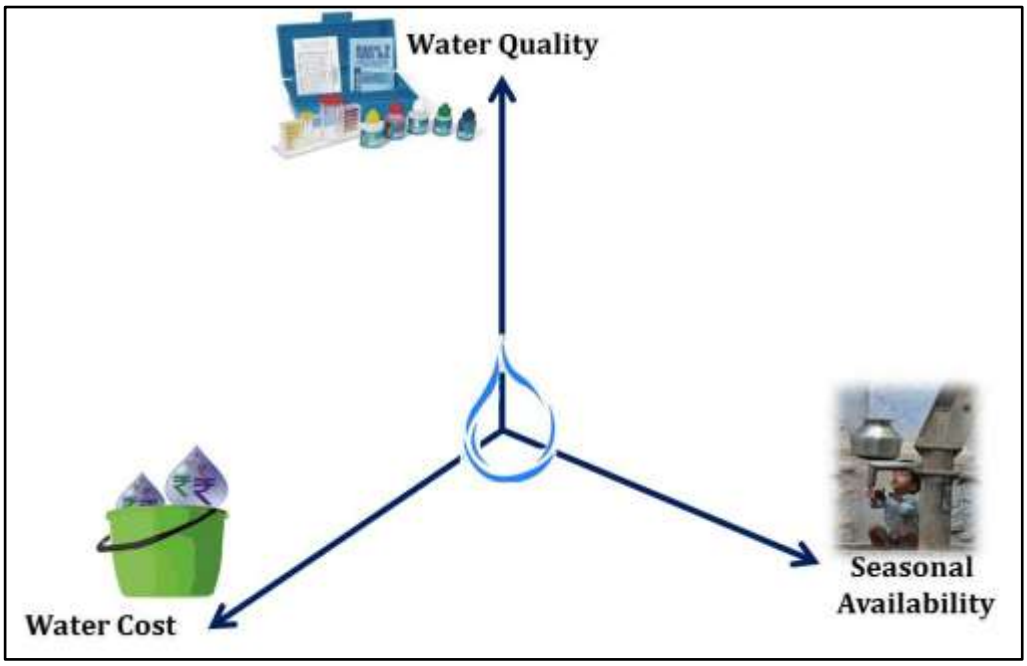
1.1. Conjunctive Water Management

Urban areas in developing countries face water shortages due to a variety of reasons including growing population, lag between infrastructure investments and demand growth, poor distribution systems and insufficient revenues to manage the operations and maintenance. As a result a significant section of the population have to depend on a variety of semi-formal and informal water sources including public and private bore wells, tankers and informal water markets.

With growing demands, the cities are increasingly depending on distant sources due to insufficient local sources often involving significant energy costs for pumping. High reliance on centralized supplies based on distant sources has resulted in neglecting the traditional as well as local sources. Also, the lack of sewerage and drainage results in pollution of local water sources, resulting in severe degradation in quality. With the increasing proportion of the population unable to access the centralized supply, there is a need to conserve local sources that serve the informal as well as underserved population.

Conjunctive Water Management (CWM) of local and distant sources is necessary to manage the ever growing crisis of urban water supplies. The CWM emphasizes understanding demand and meeting the demand through judicious mix of the local as well as distant sources based on quality, availability and cost considerations to match various types of demands. This concept further emphasizes the demand focused end use. The CWM requires thorough understanding of local as well as distant resources (quality and availability and spatio-temporal distribution of resources), quantity as well as quality considerations for various types of demands, socio-economic situations of the communities and their interest and willingness to pay and manage their local resources. Figure 1-1 depicts the three most important issues related with urban water issues.

Figure 1-1: Urban Water Issues



Source: TARU Analysis, 2011

Water quality is the most important issue that can impact urban health. In many semi arid and coastal areas the ground as well as surface water may be hard or saline. Contaminated aquifers, leaking pipes in urban areas also cause the bacterial contamination.

Cost of water in most urban areas of the country is highly subsidized. These subsidies cripple the capacity of the municipalities to invest on water infrastructure as well as maintaining the services. This often leads to demand not met by the supply leading to large private investments on coping mechanisms including storage, private wells, tankers and other informal arrangements. The communities, especially poor are often unable to access the municipal water supply, while rest get less than their demands, and invariably all communities end up in paying for coping costs.

Availability is another major issue. Almost none of the cities are able to provide 24 hour supply. The seasonal scarcity is another major problem, which is partly met by tankers. The households, especially poor end up spending considerable amount of time for water collection at less than the actual demand.

During the Asian Cities climate change Resilience network phase II period, water sector studies and a pilot project on CWM was taken up to understand different dimensions of water crisis were undertaken. The pilot studies on Conjunctive Water Management were undertaken covering four settlements (representing slum, middle income and upper income settlements). These studies identified water as an important sector requiring immediate attention for deeper engagement.

These studies provided settlement level and household level information on water supply, demand and water usage practices. The data indicates that while the city has been unable to meet demands, the local sources have the potential to meet some of the demands to build the resilience of the communities, especially the poor. Based on this, the intervention project has been planned for four communities. The overall

aim of the project is to improve the access to water to urban residents, especially poor to build climate change resilience. The objective of the project is to build replicable models for community based conjunctive water management combining local and distant sources.

1.2. Indore Context

The population of Indore is about 2.5 million. About 90% of the public water supply in Indore is met by surface water and about 10% from the groundwater. The city is also served by more than 40,000 private bore wells. Presently, the per capita availability of water is very less (~80 lpcd) compared to national norms (135 lpcd) set by Central Public Health Engineering and Environment Organization (CPHEEO).

Indore city has been facing water crisis despite two phases of Narmada river based projects. Dilapidated infrastructure, high distribution losses and poor revenues have contributed to this crisis along with growing population.

CHAPTER 2: METHODOLOGY

Community Context Analysis is the first step to understand different dimensions of water crisis and develop suitable options for the Conjunctive Water Management Practice. This study is focused to provide a design brief for developing options considering the water resource, consumption pattern, socio-economic and institutional situation in the communities.

A workshop was held for the Rahul Gandhi Nagar Community to collect this information through participatory GIS and focus group discussions followed by verification and sample household surveys.

A detailed map was prepared to analyze and present the data and to understand spatial distribution of various water resources and infrastructure. Thirty Sample people from different parts of the settlement were invited to the workshop to present the information.

The first part was a Focus group discussion with all the participants providing information on community level institutions, current water management system and the water interventions undertaken by external agencies as well as the community. The main issues discussed were:

- Water related issues coping mechanisms including community arrangements for water supply, time spent for water collection.
- The community level plans for improving water supply
- Government and other interventions on water supply, sanitation and drainage
- Existing institutions including festival groups, self help groups etc.

The second part consisted of a World Café exercise with six spate groups representing six parts of the settlement. Each group had five people and they were asked to provide information about their family and neighbors. On an average each participant was able to provide information on five to six neighboring houses.

Map Based Data collection: A base map and a set of tables were used to collect data from the world café exercise. The base map contained building footprints as well as important land marks and streets to facilitate recognition of their houses in the map. It was found that for some people it was difficult to identify the house. Socio-Economic and Water use profile of the community was collected with six themes as presented in the following Table 2-1.

Table 2-1: Themes for the Community Context Analysis Data Collection

Theme	Data
Settlement Details	House type including roof type, Ownership and use of the building
Kinship/Origin	Place of origin and time of stay in the settlement
Education	Literacy level of members of households
Occupation	Earning members and occupation
Water Sources	Water sources used
Water Storage Capacity	Household level water storage facilities
Infrastructure	Road, Water supply line, Sewerage line, Electricity line, School, Solid Waste Disposal etc.

These themes were transferred in to the map prepared for the Rahul Gandhi Nagar.

Field Verification: To validate the data, field check was conducted, the correct location or number of house was identified with the GPS and transferred to the map and necessary corrections were done to overcome the limitations. Fresh data was collected, wherever data errors were noticed. A total of 146 full household records were used for analysis.

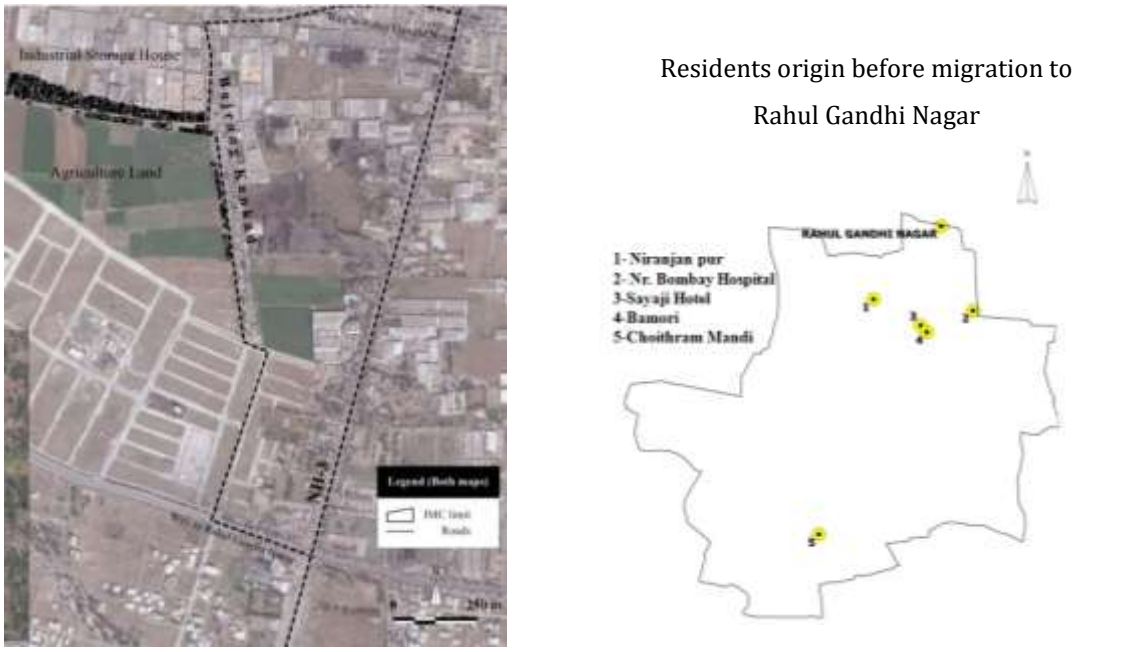
CHAPTER 3: CONTEXT

3.1. Location, access and spatial context

Rahul Gandhi Nagar (RG Nagar) is situated in the northern edge of Indore Municipal Corporation (IMC) limits near Dewas Naka. It is located at a distance of about (1 km) from AB Road, (NH3) Indore and is connected through a tar road. RG Nagar is a typical urban slum. There are industrial storage houses situated in northern side providing employment to few residents. The southern & western part is covered mostly by agriculture land. Bajrang Kankad settlement (a part of Lasudiya Panchayat), is located in the eastern boundary of RG Nagar which is outside the IMC limits.

The Rahul Gandhi Nagar settlement is "L" shaped (inverted) with the main settlement oriented east to west and a new addition of about 100 households with north-south orientation. The latter part is called New Basti and is occupied mostly by rag-pickers, who have settled here since last 8-10 years. This part was recently added in to the RG Nagar. The following Figure presents the location of RG Nagar.

Figure 3-1: Location Map: Rahul Gandhi Nagar, Indore & Migration Area



Source: TARU Field Study, 2011; Google Earth

There are about 850 households in the settlement including 100 household in "New Basti".

In the year 1997-1998, IMC relocated several informal settlements from various parts of the city in to the current RG Nagar area. During the TARU survey, residents informed that they were shifted in to an open land for weeks in the early days of their arrival in the RG Nagar. The IMC provided them some clothing and food; they prepared temporary shelters and slowly built the Kaccha Houses.

Most of them were relocated from a place called Bajrangnagar (near Bamori in map). Rest came from Bamori (350 households), Niranjanpur cross roads (50 hhs), Choithram Mandi area (50 hhs) and some are relocated from slum neighboring Sayaji Hotel (Figure 3-1 right panel)

Each household was given a plot of 12 ft X 30ft. In the early days, there was minimal water supply through hand pumps installed by Indore Development Authority (IDA).

The New Basti people were relocated from a slum locality behind Bombay hospital. New Basti residents were given 12 ft x 25ft plots. Now after 15 years, these people in the community are well integrated.

RG Nagar was chosen as one of the 19 slums selected to provide basic services under DFID funded Madhya Pradesh Urban Services for the Poor (MPUSP[1]). MPUSP is a five-year (2006-11) programme and is intended to deliver four major outputs:

- Enhancement of state capacity for urban poverty reduction
- ULB Financial management and information system improved
- Participatory and citizen centric governance
- Improved access to basic services to urban slums and sustainable water management.

In RG Nagar, the MPUSP has laid concrete streets, built sewerage lines and installed bore wells for drinking water. Recently, individual water connections outside each house house are provided in the community, which are ready to be connected to the pipeline for water supply from the bore wells.

3.2. Current Population, Households

The family sizes of the community ranges between 4 to 10 persons and with an average of 5 family members. The combined population in the Rahul Gandhi Nagar is approximately 4250. There are about 200 children attending the "Anganwadi" (excluding new Basti). In the New Basti Rahul Gandhi Nagar, "Basix" an NGO has initiated an education programme for the children of rag pickers.

[1] MPUSP is funded through a £41 million grant from the UK government's Department for International Development, working in partnership with the Government of Madhya Pradesh. Around half of this will go to the four programme cities to carry out priority slum improvements. The remainder will support state and ULB governments to bring about reform to improve the ways in which they provide services to poor people. http://www.mpurban.gov.in/mpusp/About_Us.asp

CHAPTER 4: SOCIO-ECONOMIC CONDITIONS

Rahul Gandhi Nagar is an urban slum of Indore with, most of the inhabitants engaged in manual unskilled and semi-skilled work in the informal sector. In order to get the socio economic profile of the RG Nagar, data of 146 households were analyzed and presented in the following sections. Apart from that, the information of DFID survey (2009) was also assessed for understanding the occupation pattern, asset ownership and literacy levels.

4.1. Occupation pattern

The DFID survey indicated that out of the 412 sample households, nearly 90% of the head of the households were engaged in manual labor, 6% were semi-skilled workers and 1% was engaged in regular jobs and about 2% were petty traders. Most of the laborers are construction workers, or working as manual laborers in small and medium business firms and local shops. With uncertain incomes, these households are unable to invest on housing and other permanent assets.

4.2. Asset ownership

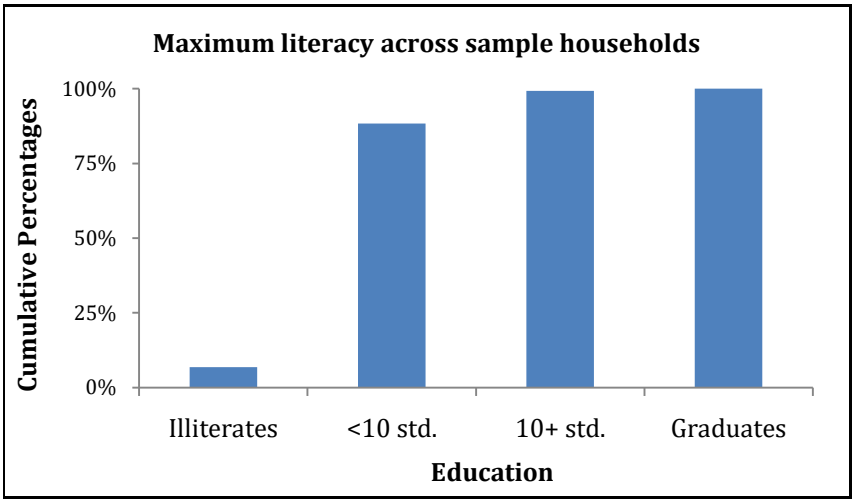
Nearly 60% of the households reported owning the mobile phones and nearly 50% of the households own television sets and have cable connections. They pay around Rs. 150 per month for cable connections. About 50% of the households surveyed reported owning a bicycle while only 15% owned scooter or motorcycles[2]. About 82% of the surveyed households reported owning the house; most of it is single storied kutcha houses.

4.3. Education

The education data is presented as the maximum education attained by any member of the sample households. The following Figure presents the maximum education status across the sample households

[2] MPUSP household survey: Sample size 509

Figure 4-1: Distribution of Literacy Level in the community



Note: N=146

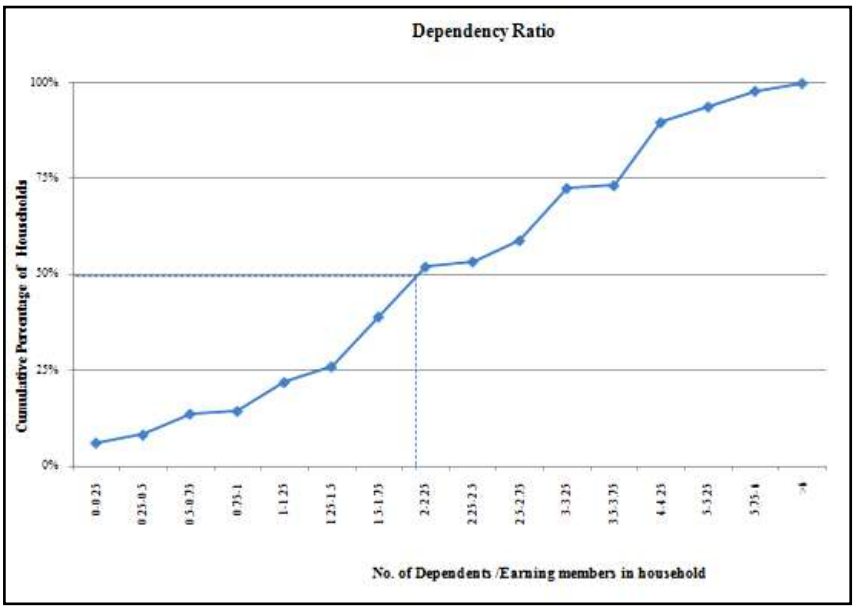
Source: TARU Field Survey, 2011

About 7% of the sample households have all members illiterate, but about 80% of the households have the maximum education of less than 10th class. These figures means that medium or higher education based livelihood options are not open for the majority of the households. Low literacy status also indicates possibility of low level of awareness about the issues related to services and living challenges in urban environments. Awareness generation activities need to consider the low literacy level of the community.

4.4. Dependency ratio

Dependency ratio is the number of nonworking age (<15 and >64) population divided by working age population (>15 to <64 age). For the purpose, we used ratio of number of non-working people in household to number of working members in the households. It provides an estimate of number of people supported by a working member at household level. High dependency ratios mean that the larger number of persons in a household is financially supported by incomes from less number of workers. Figure 4-2 shows the dependency ratio across the sample households in the RG Nagar.

Figure 4-2: Graphs showing household level dependency in the community



Sample Size=146

Source: TARU Field Survey

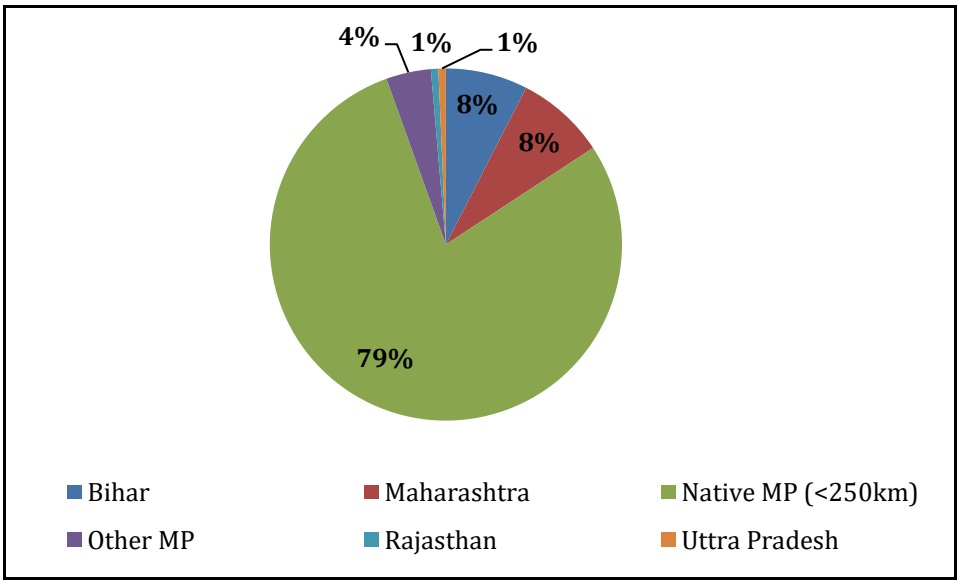
Nearly half the sample households have more than 2.5 persons dependent per earning member, which indicates the vulnerability of the households to income related uncertainties of earning members, especially considering nearly 90% of workers in informal sector. This indicates that most of the households have limited income and are vulnerable to the income uncertainties.

CHAPTER 5: KINSHIP AND SOCIAL COHESION

Mostly, the households of RG Nagar belong to Hindu religion. Despite being relocated from many places 15 years back, the community is well integrated. However, the New Basti residents are comparatively poorer, but there are no reported conflicts between new and old settlement residents.

The residents came to Indore more than a generation back from various parts of the state and neighboring states and have kept their identity closely related to language and place of origin, customs and rituals. The distribution of households based on their stated place of origin is presented in the Figure 5-1.

Figure 5-1: Distribution of place of origin for RG Nagar people



Note: N=146

Source: TARU Field Survey, 2011

Maximum numbers of households among the sample are from Indore or neighboring areas. Indore being located in the semi-arid region and with underdeveloped areas (complex diverse and risk-prone environments) in the neighboring districts attracts large population migrating due to with uncertain rural livelihoods. The land quality is poor, droughts are common and landlessness is also quite high in the neighboring regions.

CHAPTER 6: HOUSING

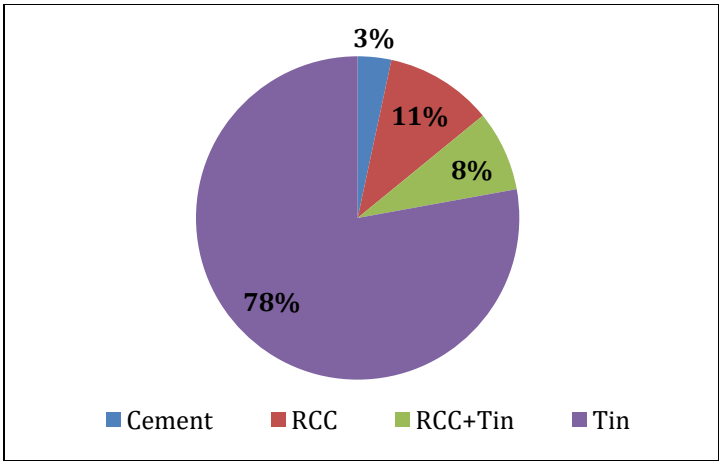
Rahul Gandhi Nagar is an urban slum but with proper access paths, since plots assigned to each household were planned with a main access road and streets. As observed during the study, the housing conditions are poor, with most of the houses built to occupy the full plot assigned to each household (approximately 300 sqft). Since the built up space is very low, houses generally do not have rooms and people tend to live in a single hall which is sometimes divided by temporary partitions to form kitchen and living room. Over the day the activities changes, in the day time whole area is used as living area and in the night, used as a sleeping area. Some of the houses have prepared temporary verandah (a platform with stones) facing the streets. This area is often used to keep drums and utensils filled with water for the daily household usage.

As indicated in the study, the family size is in the community range from 4 to 10. The per capita gross floor area ranges from 30-90 sqft. which is insufficient to accommodate the family. People live in crowded conditions with very limited amenities inside the house.

6.1. Roofs & Walls

Most of the houses are of un-engineered type. As indicated in the survey, their walls are constructed with bricks with mud/cement mortar or wooden planks. The roofs of the houses are predominantly tin sheets and also in some cases asbestos cement sheets. As shown in Figure 6-1, 78% households in the community have tin sheet roofs, 11% have RCC roofs.

Figure 6-1: Distribution of Roof Types in RG Nagar



Note: N=146

Source: TARU Field Study, 2011

Some of the houses with two stories have two different roof types - ground floor with RCC roof and first floor with tin sheet roofs. About 8% houses in the community have these types of roofs.

There are also houses which are completely informal and complex type and constructed by tin sheets, plastic sheets, wooden sheets etc. These houses are especially common in New Basti, where mostly people are rag- pickers, using material scavenged from the wastes disposed from various industries and trades.

The Figure 6-2 presents the map of roof types of sample houses of the RG Nagar. Most of the houses have a cemented floor or in rare cases- stone tiles scavenged from the construction waste materials around the city.

Figure 6-2: Map of Roof types in the Rahul Gandhi Nagar

Note: N=146

Source: TARU Analysis, 2011

The roofs of most houses do not have a good understructure and slopes are highly variable. Since the shorter span is about 10 feet or less, the roofs slope to one direction only. Most of the houses have the tin sheets, thus most of the rainwater can be collected falling on the roofs, if the roofs are modified with a single rain gutter and pipeline. However, lack of space is the main issue for storing the collected rainwater. This can be only be overcome by having underground tanks in the households or centralized recharge systems.

The photographs for the different roof types in the settlement are presented in the Figure 6-3.

Figure 6-3: Photographs of Roof Types in the Rahul Gandhi Nagar Community

Informal type house

Kachha type House

RCC & Tin Roof

Stand Alone House type

Cement Sheet as Roof Tops

CGI Roof on Health Center

Roof Types at a glance

Space outside house used for water storage

Source: TARU Field Study, 2011

CHAPTER 7: COMMUNITY INSTITUTION

7.1. Festival groups

The community joins together and celebrates common festivals and collect funds for expenses. Holi, Ganesh Puja and Navratri are the common festivals celebrated by all. The monetary collections are made for mainly for food and entertainment.

Each of the clans also celebrates their own festivals. One of the examples for such celebration is "Chhat Puja" celebrated only by people of Bihar. They have built a tank to collect water essential for celebration of this festival. This tank is located at the junction between old and new settlement.

7.2. Saving groups

There are established as well as newly formed saving groups catalyzed by the government/NGOs in the settlement. The traditional group saving among the women is called "Beesee[3]". It is a type of chit fund, where the each member contributes a fixed amount and the money is given to one of the members in turn each month. There are at present eight Beesee operational in the settlement. The monthly collection of the group varies between Rs. 100 to 500. Some of the Bisee groups are planning to undertake some kind of livelihood based training (e.g. tailoring training).

There are 13 self-help groups (currently eight groups managed by SKS and five groups by Share Micro Finance) who also collect money on monthly basis and the money is given as loan among the members with interest. They were initially formed by the Bharathiya Grameen Mahila Sangh (BGMS) with support from the government. The savings are maintained in banks. These groups hope to get matching grants from the government schemes and take up common income generating activities. A survey done by MPUSP in the year 2009, reported 57 women out of 498 households being members of Self Help Groups (SHGs). Some of the SHGs also have taken loans from formal microfinance organizations.

The households also contribute for marriage ceremonies as well for medical emergencies. These institutions, formal as well as the traditional indicate mutual trust within the community and can be potentially leveraged to manage basic services.

[3] The concept of Beesee (twenty in Marathi language) has originated from Maharashtra. This is a closed saving group among middle and lower class families. Members (mostly women) collect minimum twenty rupees per month and this collected amount is given to one individual on lottery basis with reducing number of persons every month(once a member gets the amount, she will not be eligible for subsequent round of lottery, but would contribute the monthly amount). The group is ideally formed by 12 members.

7.3. Other institutions

During 2006-2008, BGMS-an NGO- started working in this settlement on various issues including health, water supply and sanitation. RG. Nagar is one of the settlements chosen by IMC for MPUSP (Uthan), with the Feedback Ventures as project management consultants. They trained the community volunteers who were later, incorporated in the other community programmes.

The Utthan project has carried out capacity development activities on various development issues relevant to the locality's needs. They have selected 14 persons as Representative Community Volunteers (RCVs).

1. Dekh Rekh Samiti (supervisory committee) with 8 members – This committee looks for the quality of the construction, maintenance of the structures constructed and takes care of the available community assets (to prevent digging of the roads or breaks the pipeline etc).
2. Basti Vikas Samiti (Settlement Development committee) - 11 members- This committee focuses on social development and liaisons with the IMC and other agencies.

The Utthan project has built RCVs' capacities to conduct surveys, manage community contracts and maintain community infrastructure. They were trained in accounting and management of civil works etc. Utthan project has undertaken several interventions including water supply, concrete paved streets, Anganwadi and other community level interventions aimed at improving access to basic services to the community.

7.4. Leadership

The BGMS developed the leadership in the community through volunteers, which was later strengthened by the Utthan interventions. Women form the bulwark of leadership in this community through "Basti Vikas Samiti" forum. This forum manages most of the community level interventions under Utthan project as well as deals with the daily problems and liaisons with the IMC as well as elected representatives. At present, two women are taking up most of the leadership roles. These groups have matured to some extent and are vocal enough in expressing their concerns and also have vision for improving the community level basic services. For example, during the FGD, they raised the concern regarding the over extraction of the ground water and wanted the ground water recharge systems to prevent possible drying up of the bore wells. They would require continued support to manage the services and to mature to take up more important roles.

CHAPTER 8: WATER RESOURCES

8.1. Hydrogeology

The Indore city is drained by Khan and Saraswati River. The River Khan flows about a kilometer away in the western side of the Rahul Gandhi Nagar. The general slope of the settlement is towards north. The average rainfall of Indore is about 900mm with high variability in annual rainfall over years and drought years are common.

The settlement is underlain by Deccan trap basalts. The semi-weathered layer intervening soil and the hard rock, Inter-Trappeans as well as fractured and vesicular basalts form aquifers in the area. Since this settlement and surrounding area has open land and low density of bore wells, groundwater has not reportedly shown any significant decline in the past few years, as informed by the community.

8.2. Depth of water table & water yield

There are five bore wells in the community for daily water collection. Out of which one has hand pump and rest are motorized. The average depth of the bore well in the community is about 370 feet. As per the residents, the water table is about 65 to 100 feet below ground level. Most of the bore wells have yield of more than 8 lps (considering 5 to 7 HP pumps, about 100 ft depth of water and continuous flow). Only one well reportedly has intermittent flow, indicating low yields. With motorizing of new wells and establishment of piped supply in the settlements, increased extraction from neighboring Bajrang Kankad (with house level connections), and new settlements coming up nearby, ground water decline is expected in the near future. There is need to set up recharge systems. Utthan RCV group has realized this issue and expressed their interest in commissioning of ground water recharge systems to ensure source sustainability.

8.3. Water Quality

Five samples were analyzed for water quality details of the community during the pilot project in phase II (CEPRD report). The analysis indicated that the pH of the water from the bore wells varied from 7.3 to 7.5. Hardness values reported ranged between 230 to 250 and the turbidity of the water was between 1.1 and 1.5. None of the samples reported the *E-coli* in the samples analyzed by CEPRD.

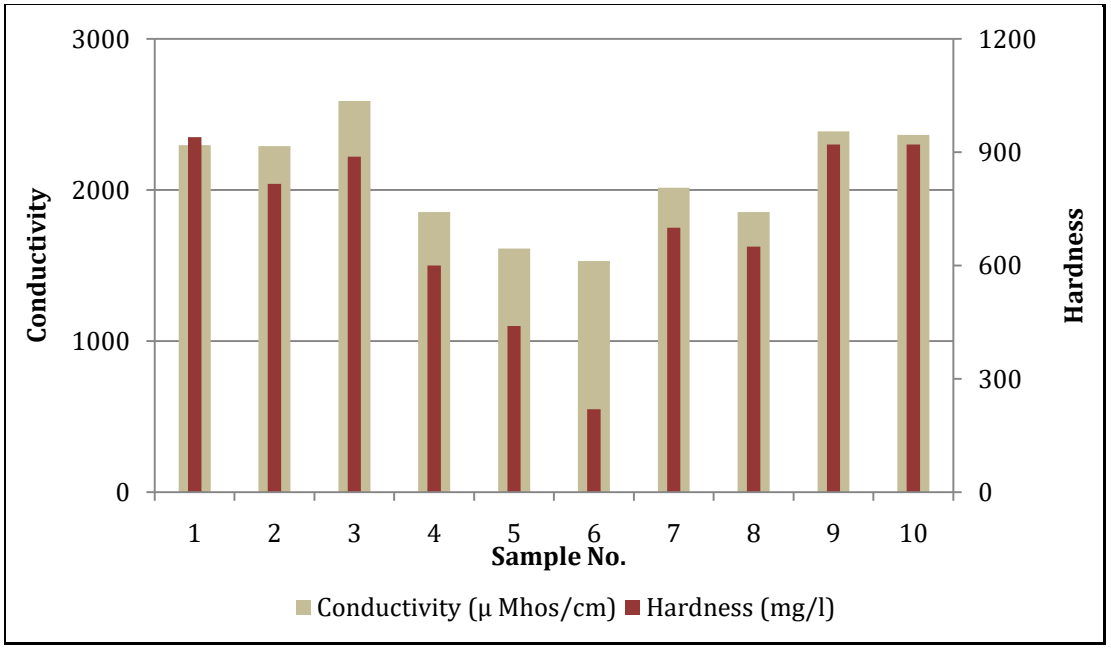
The hand pump in the neighboring Bajrang Kankad has high iron content and people reported yellow color development. The water from Panchayat bore well in Bajrang Kankad reportedly causes curdling of tea (milk), may be due to presence of iron or being acidic.

Recently (June 2011), ten samples were collected from the community for the water quality test. Out of ten samples, one sample was collected from the house to test the

difference in the quality from source. The analysis of samples was carried out at Madhya Pradesh Pollution Control Board Regional Laboratory, Indore.

Conductivity, hardness and fecal coliform were measured for the collected samples. The results indicate hardness ranging between 220 to 940 mg/l with 657mg/l as average. The values obtained are high compared to the permissible limits in BIS 10500: 1991 (300-600 mg/l). Conductivity values were ranging between 1531 to 2388 µ Mhos with an average of 2000 µ Mhos. The fecal coliform values obtained ranged between <1.8 to 25 MPN/100ml. Three samples had 25, 12 and 8.3 MPN/100ml and other samples had fecal coliform count of <1.8 MPN/100ml. As per the BIS 10500: 1991, no samples should contain >10 MPN coliforms /100ml. A sample collected from the house showed 5.6 MPN/100ml. The Figure 8-1 provides the results of water analysis. The sample collected from the water source and from the house did not reveal much variation in the measured parameters.

Figure 8-1: Conductivity and Hardness of water samples of the community



Source: TARU Field Study, 2011

The fecal contamination is possible through direct seepage of waste water through bore wells. Stagnant water was observed near two bore wells in the Rahul Gandhi Nagar which had no sealed bore well platform and the casing was partly submerged.

The lower values of hardness in the study of CEPRD (230-250) may be due to the the water recharging in the monsoon season.

8.4. Investment on Water Resources & Water Management:

Presently, groundwater is the only water source for the community. The bore wells providing water are developed by Municipal Corporation. Five bore wells are used by the community for meeting the water requirements.

Water is collected directly at the source by people. The IMC has laid water pipeline with water tap at the doorstep of each house, but this system is not functional yet and is expected to be commissioned by August 2011. People generally use the nearest source. However, in there is too much crowd at the nearest source, the water from next nearest source is chosen.

During the survey, people reported that no charges are levied on them for the water and they get it for free. The electricity bill is also presently paid by the corporation and only minor and routine maintenance costs are borne by the community. Even though the water is currently available free of cost, in order to understand the water economics, following estimates were worked upon.

8.5. Investment by Corporation:

The Rahul Gandhi Nagar community had piped water supply three year back. Earlier (till 2008) before the Utthan project, about 300 households were contributing Rs. 10 for the routine maintenance of the water taps (that time in each street there was one such tap). They were effectively using the collected money for replacing old pipes, checking leakages, and even calling IMC technicians for repairing work

The average depth of the bore well in the RG Nagar is 370 feet and the water table is about 65 to 100 feet below ground level. To develop one bore well in this region, Corporation has spent about Rs. 1,50,000 (Rs. 0.15 million) in the year 2010. The bore well cost includes drilling, casing (for soil zone), installation of electricity motor of 7HP and the cost of riser pipes. The cost of electrification, labor costs etc. are not included in this estimate. The people informed that the monthly electricity bill to corporation is about 4,000 to 5,000 Rs. However, out of the five functioning bore wells in the settlement, only one has legal electric connection, rest do not have meters. If only the electricity costs are taken in to account it works out to be about 8-10Rs/HH.

It has to be noted that in the neighboring Bajrang Kankad settlement, each household pays Rs 50/pm for single tap connection (outside the house). The RG Nagar residents will be able to pay similar amounts, which can meet all O&M costs of the system including electricity, modest operator costs and pump repair costs.

8.6. HH level investments:

Individual household in the community have built coping mechanisms to meet their requirements. Apart from using the water resource available in the community, at times they have to depend on nearby community resources also (Bajrang Kankad). The households store water in drums and utensils (34% and 100% respectively). About 8% households in the community have underground tanks to store the water with capacities between 5,000 to 10,000 liters.

There are two private bore wells in the community. As per Mr. Akhilesh, one of the residents in the colony, their family spends Rs. 400 towards the electricity bill for the 150m deep bore well.

CHAPTER 9: SETTLEMENT LEVEL INFRASTRUCTURE

9.1. Roads

Rahul Gandhi Nagar had only mud roads two years back. Under Utthan project, all the streets were paved with concrete and also the sewerage line was laid (not functional yet). Since the concrete roads are at a higher level than the floor level of most houses, the water logging problems can be expected, unless the sewerage and drainage systems are made operational.

Figure 9-1: Photograph of Road & Water Pipeline in RG Nagar

Source: TARU Field Survey, 2011

9.2. Water supply

Groundwater is the only water source in the community. There are four motorized bore wells in the community developed by Municipal Corporation (B1 to B4[4]) over the past eleven years. Apart from these, there is one hand pump which non-functional since last couple of years. The list of main sources and their status is presented in the following Table 9-1.

[4] B2 bore well has a stand post with four outlets. B4 was non-functional for few months: It was repaired recently.

Table 9-1: Details of Bore wells in the RG Nagar and Bajrang Kankad

Bore Well	Ownership	Depth (feet)	Motor Capacity (HP)	Installation year	Water Yield	Quality (taste / smell / color)	Remarks
B1	IMC	240	7	1999	High	Good	Earlier Hand Pump
B2	IMC	550	10	2008	High	Good	Stand Post (4 taps)
B3	IMC	350	10	2001	High	Good	Centre of community
B4	IMC	350	10	2009/10	High	Good	Casing changed in 2011
B5	IMC	350	7	2009	Intermittent	Good	Bajrang Kankad
HP	IMC	NA	NA	NA	NA	Poor	Bajrang Kankad. High iron-yellow water
List of other & the non-functional water sources for RG Nagar and neighborhood (Figure 9-1), HP- Hand Pump							
1	IMC	NA	NA	2011	NA	NA	Earlier HP converted to bore well, Near new community toilet. Presently Non Functional
2	Private	NA	NA	NA	NA	NA	-
3	Panchayat	250	NA	NA	Medium	Poor	Bajrang Kankad. Milk Curdling problem reported. Water Charges Rs. 50hh.
4	Private	NA	NA	NA	NA	Poor	Bajrang Kankad, uses water for selling. water contamination reported due to septic tank.
5	IMC	NA	NA	June, 2011	NA	NA	New Basti Bore well
							Functional post this study.
HP	IMC	NA	NA	NA	NA	NA	Presently, non-functional but do not have problems

Source: TARU Field Study, 2011

There are two types of arrangements for distribution namely

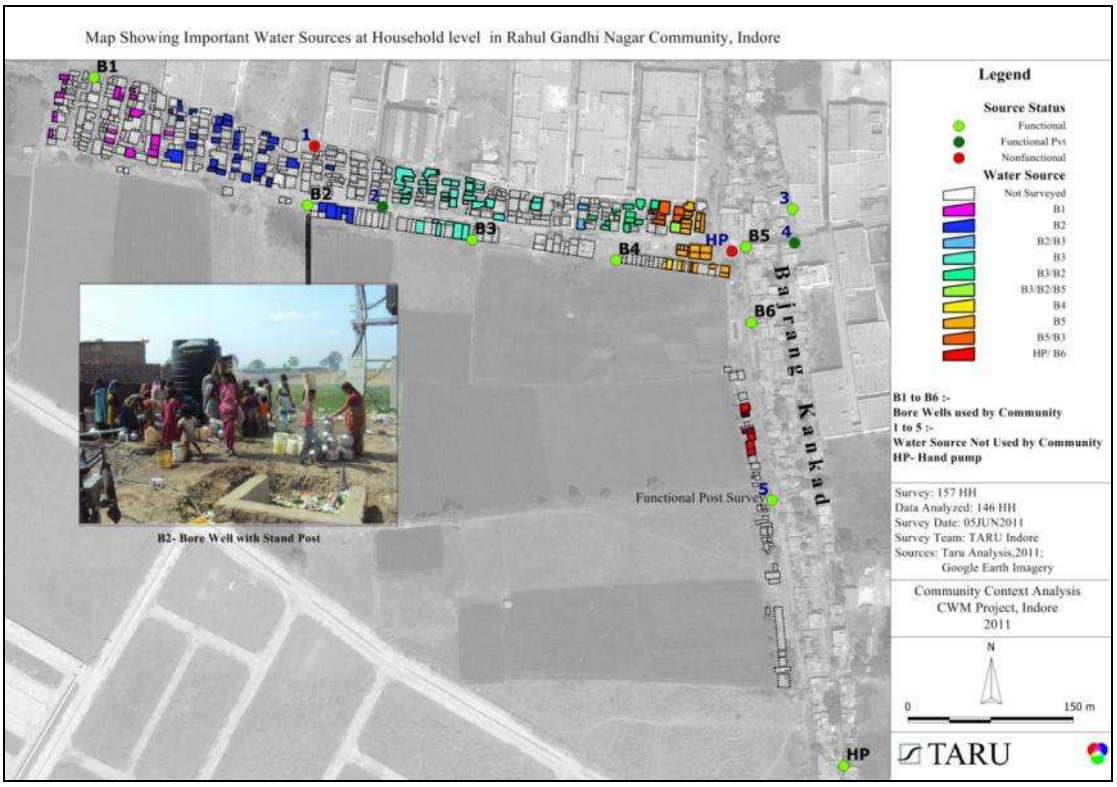
a) Direct supply at the bore well outlet,

b) Temporary storage in large PVC tank (10,000 liters) with multiple outlets.

Water was supplied through pipeline in community before the construction of the concrete road in the community, which got damaged during the construction of new road. With the result, the numbers of outlet have reduced and crowding near the few number of public taps has increased. Most of the households use the nearest source of water. Some of the households use multiple sources of water depending on the crowding at the source. There are also two private bore wells in this settlement.

The water is supplied for about two hours each morning and in case of emergencies or festivals, additional water is supplied. The switching of the motors is managed by the leader of Basti Vikas Samiti.

Figure 9-2: Map Showing Water Source for surveyed house in RG Nagar



Source: TARU Field Study and Analysis, 2011

Figure 9-2shows that none of the households need to travel more than 100 meters to collect water during normal operation of all the bore well pumps. However, in case one of the motor breaks down, the residents may have to use the next nearest bore well.

9.3. Other supply sources

Other supply source includes the neighboring Bajrang Kankad's water supply system. This settlement has installed a bore well based (B5 & B6) piped water supply system with taps in the front of each house. Each household has to pay Rs. 50/month to the Panchayat. Some of the residents of New Basti use this water source by paying some amount to the house owners of Bajrang Kankad . Also there are few bore wells in the neighboring fields which are occasionally used by the residents. Also hand pump in the Bajrang Kankad community is an important source for New Basti residents located at the southern end of the settlement.

Figure 9-3: Water Supply Sources in RG Nagar

Water connection in front of each house (non-operational)

Temporary storage at source with multiple outlets

Source: TARU Field Study, 2011

9.4. Water availability with changes over last five years

Water availability[5] in the community has significantly improved during past five years due to installation of motors and storage tank and new bore wells added. One bore well was drilled in the year 2009 (B5) and two bore wells with hand pumps were motorized (Refer Table 9-1 & Figure 9-2), B1 & 1 of RG Nagar. One more bore well was drilled recently in the New Basti (5), which had to depend on Bajarang Kankad water sources. However, due to breakdown of the pipeline, numbers of outlets have decreased resulting in increasing time wasted for collecting the water by households. The newly installed water supply line with individual connection to each house is expected to be operational soon (August, 2011).

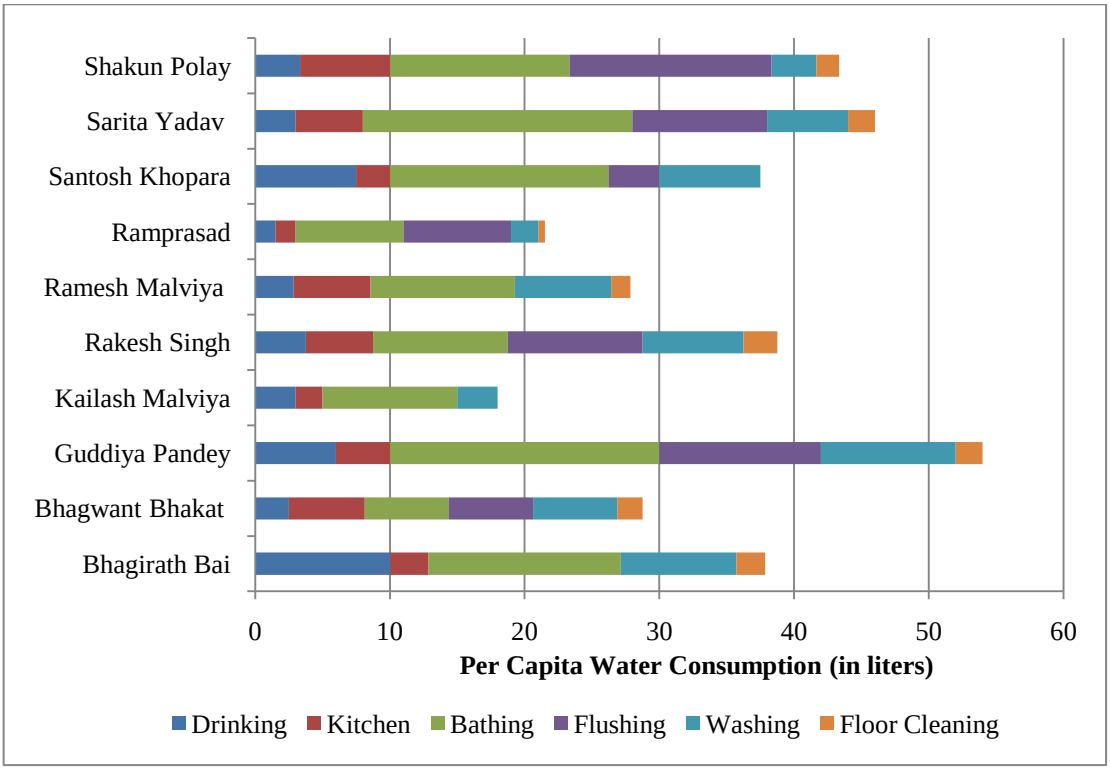
[5] Refer the Bore well Summary Table No. 2 for bore well numbers

CHAPTER 10: WATER CONSUMPTION PATTERN AND WASTE WATER

10.1. Household level water consumption pattern

HH level consumption pattern presented in this chapter is based on 10 household surveys in the community. presents the per capita water consumption distribution for various activities in a day. The water consumption across these households varied from 90 to 265 liter/day/family. Per capita consumption ranges between 20 to 60 liters which is much less from the prescribed per capita urban water supply availability of 135 lpcd. Some activities involving water usage are performed at the source or outside the house immediately after the collection (e.g. cloth washing) and therefore, this figure cannot be ascertained. Even if 135lpcd water is supplied, without sufficient sewerage/drainage the water logging can be expected in this flat, black cotton soil area.

Figure 10-1: Per capita Water Usage Profile across sampled Households

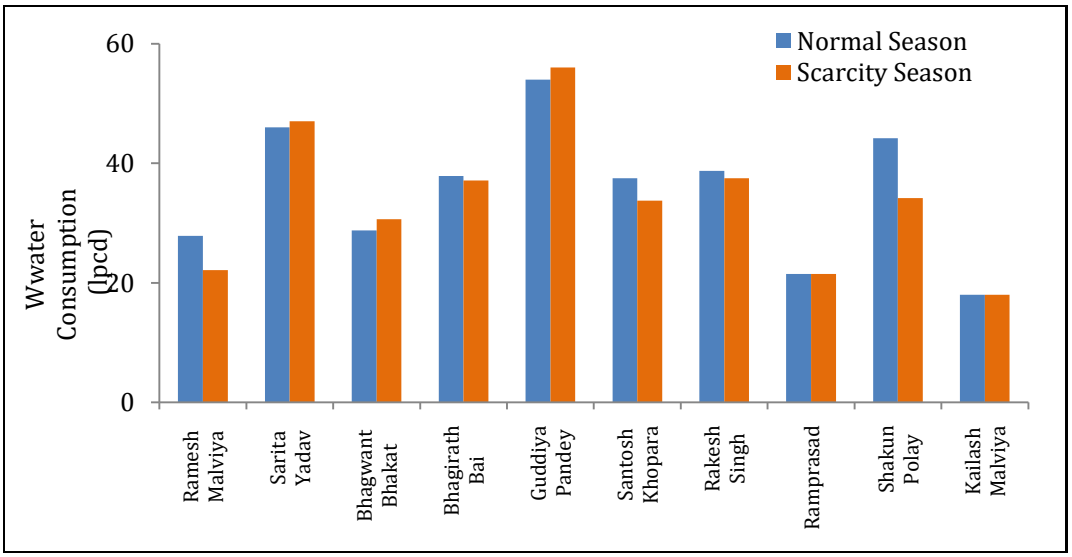


Note: N=10

Source: TARU Field Study, 2011

Following Figure 10-2 presents per capita daily water consumption of 10 sample households for normal and summer time.

Figure 10-2: Per Capita Consumption during Normal and summer seasons across sample households



Note: Sample size - 10 households

Source: TARU Field Study, 2011

Some households have reported higher consumption during the summer time. This can be attributed to high drinking and bathing requirement during summers. It means that there is no scarcity during summers. Table 10-1 presents the per capita water consumption and storage capacity.

Table 10-1: Per Capita Water Consumption

Respondent Name	Family Members	Water Storage Facility (Liters)	Per Capita Storage Facility (Liters)	Per Capita Consumption (Lit/Day)	
				Normal Season	Scarcity Season
Ramesh Malviya	7	330	47	28	22
Sarita Yadav	5	350	70	46	47
Bhagwant Bhakat	8	700	88	29	31
Bhagirath Bai	7	250	36	38	37
Gudiya Pandey	5	3,850	770	54	56
Santosh Khopara	8	230	29	38	34
Rakesh Singh	4	2,130	533	39	38
Ramprasad	10	290	29	22	22
Shakun Polay	6	5,210	868	44	34
Kailash Malviya	5	200	40	18	18
Average				*36*	*34*

Note: Drums and Utensils are main storage facility at house hold level; N=10

Source: TARU Field Study, 2011

The households with higher storage capacity reported generally higher per capita consumption, indicating higher flexibility in water use and limited constraints in usage.

10.2. Waste Water

This settlement does not have functioning sewerage system and waste water flows out in to neighboring fields or any low lying areas nearby. In the daily activities not all the water is consumed, but bulk of the water goes as waste water. Bathing, toilet flushing and washing are the three important activities wherein significant waste water (black and grey water) is generated. Very limited water is wasted from the drinking (in perspiration/urine) and cooking activities.

The survey in the settlement indicated that per capita water consumption ranges from 20 to 60 liters with an average of 40 liters. Thus, total water consumed by the household comes to about 200 liters/day (40x5=200 liters).

Considering the amount of waste water to be 80%, total waste water generated will be 160 liters for household of 5 members in the RG Nagar settlement. Based on this unit calculation, waste water generated per day is estimated and presented in following Table 10-2.

Table 10-2: Estimates of Waste Water Generation in the Settlement

Particulars	Details
Total HHs	850
HH size	5 no.
Population	4250
Per Capita Consumption	40 liters
HH level water consumption	40x5= 200 liters
HH level waste water @ 80%	160 liters
Water Consumption by the 850 hhs	170,000 liters (170m^3)
Waste Water @ 80%	136,000 liters (136m^3)

Source: TARU Analysis, 2011

The total waste water generated works out to be about 49 ml/yr out of the total extraction of nearly 62 ml/yr. More than 50% of the waste water is expected to evaporate since the soil is impermeable and since there is no sewerage. This waste water discharged unattended, has potential can be used for recharge with the proper treatment. Part of the waste water is discharged in the agricultural fields (today) may be increasing the groundwater recharge, since the excess water keeps the ground saturated throughout the year.

10.3. Expected changes in water consumption patterns

There are about 150 households having toilet facility with septic tanks. Recently, under DFID funded MPUSP scheme the sewerage line is laid which is presently non-operational. The household level toilet facility is reportedly increasing in the community. With availability of sewerage line and household level toilet facility, the requirement of water for the flushing activity is likely to increase in the community.

Apart from this, in future the growing population will also add up in the daily water consumption pattern of the community. The household level storage facility in the community is not sufficient due to space constraints (250 sqft.). Increased water demands is expected to increase the stress on the water resources available in the community

Apart from the Rahul Gandhi Nagar, the Bajrang Kankad the nearby community is also improving water supply infrastructure. Since the region as a whole is dependent on ground water resources, the increased demand will impose the further stress on the available groundwater resources which is likely to decline in future.

10.4. Coping mechanisms

10.4.1. Time spent for Water Collection:

The FGD respondents have indicated that each household spends about two hours each day for collection and management of water. This is largely due to overcrowding at the limited numbers of outlets (partly due to closure of the underground pipeline), even though the number of sources have increased over last decade. It is the problem of management of water supply rather than source scarcity. Also, irregular power cuts and burning of motors further amplify the water scarcity, and such uncertain situations can potentially lead to conflicts. Mostly children, especially girls collect the water from the outlets.

Women and children mostly carry out the water collection and management. Additionally, due to non-availability of proper sanitation facility, they waste one more hour in an open defecation. Thus, net about three hours daily are spent by at least one woman per household to meet their basic requirements.

About 40% women in the settlement are working as maids in the nearby areas to earn the livelihood on daily wages (about 300 women). Their daily earning ranges between Rs. 100 to 150. They leave in early morning around 7 AM for their work. The operating hours for bore wells are at 8-10 AM when there is an electricity supply. These women reported that, if they are able to save those three hours, they can work in couple of more houses which can earn extra 300 to 400 Rs. per month. The following table presents the opportunity costs compared to the water charges that can be used for improving the water supply as well as reducing the time lost for water collection.

Table 10-3: Estimates of opportunity costs vs water charges

Estimated No of working Women	300
Time lost (hrs)/ working woman	2
Opportunity costs/woman/month	300
Total amount lost due to time wasted for water collection	90,000
Water charges that can be collected at settlement level @50/hh/month	42,500

The table shows that it is more economical if the water charges are collected at household level similar to Bajrang Kankad and the community level water management is done. Since the MPUSP has already installed the pipeline, setting up community level water supply management system can significantly improve

household level economy due to reduced time wasted for water collection.

10.4.2. Storage arrangements:

Each household has some water storage arrangement. Three types of water storage arrangements are observed in the Rahul Gandhi Nagar community. They include large plastic drums, utensil of various sizes and underground tanks. Drums of varying sizes and household level utensils form the bulk of the arrangements across the households. Underground or overhead tanks are owned only by few households due to limited space (250 to 300 sqft. floor area) and also due to non-affordability.

Out of 146 sample households, all the households have utensils storage and nearly one third have drums also. Only 8 percent of households have underground/overhead storage tanks. The respondents reported that the water stored in the drum is mostly used for washing and flushing and is never used for drinking or cooking.

People have to collect water and transport it to their houses using manual head loads or vehicles of various types. Bicycles and hand carts are most common modes. Transportation is generally done by men folk, especially if bicycle is used. Figure 10-3 presents various storage and transportation arrangement prevalent in RG Nagar.

Figure 10-3: Storage and transportation arrangements in Rahul Gandhi Nagar

Water Storage Tank

Transportation of stored water from source to house

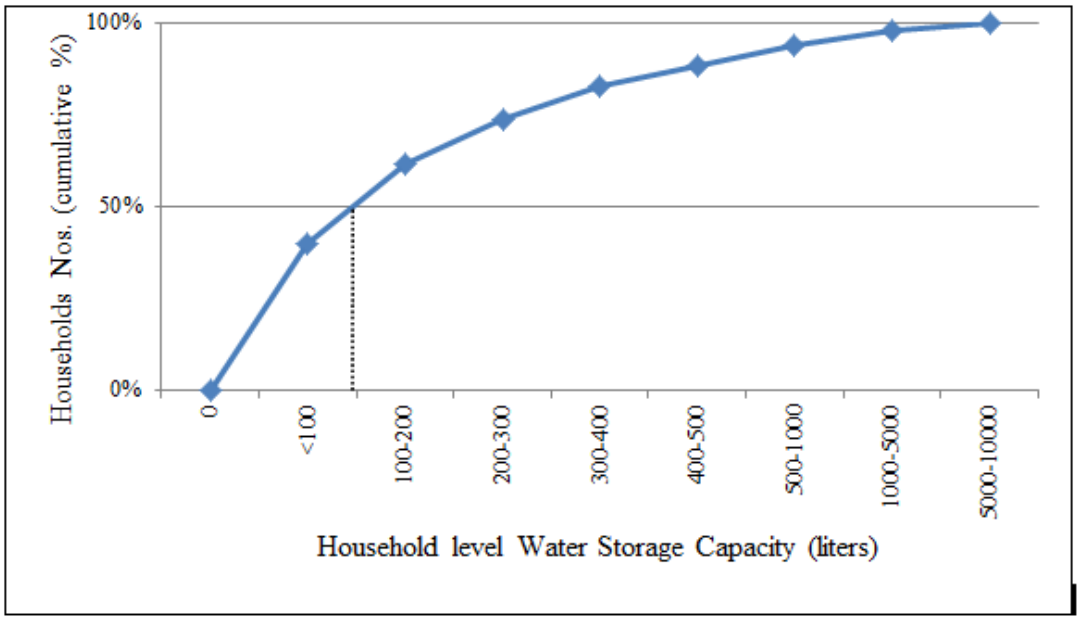
Storage capacity of the common, medium sized drums

Community Water Tank with multiple outlets

Source: TARU Field Study; 2011

The household level water storage capacity is presented in the following graph in Figure 10-4.

Figure 10-4: Storage Capacity at HH level in the community



Note: N=146

Source: TARU Field Study, 2011

Figure 10-4 Nearly half of the households in the community have storage facility less than 100 liters only. Very few respondents have reported more than 1,000 liters storage facility in the house. This indicates that household level storage arrangements need to be increased so that they are less affected by short term water scarcity. The limited space availability at household level is likely reason for not having the higher storage capacity at household level. Any additional storage can only be built as underground tanks within the house only.

10.5. Groundwater Recharge:

The area of the RG Nagar and New Basti is about 40 hectares. The region receives about 900mm rainfall and groundwater gets recharged naturally. The Rahul Gandhi Nagar settlement is underlain by the Basaltic rock types which is hard rock type. The natural recharge in such region will be of the order of 8% naturally by the rainfall. The indicative estimates of water balance at the settlement level are presented in the following Table 10-4.

Table 10-4: Indicative Water Balance of the settlement

Details	Assumptions	Recharge
Area (ha)	40	
Rainfall (mm)	900	
Population	4,250	
Water use (lpcd)	40	
a. Annual GW extraction based on lpcd (cum/yr)	62,050	
b. Annual GW extraction 5 bore wells, 2 hrs/day,	84,096	

Details	Assumptions	Recharge
8lps (cum/yr)		
Annual Natural Recharge @ 8% of RF		28,800
Annual Urban recharge @ 25% of water used		15,513
Total annual recharge (cum)		44,313
Deficit/surplus (cum) method a.		-(17,738)
Deficit/surplus (cum) method b.		-(39,784)
RWH options		
Total rainfall volume		360,000
RWH potential at colony level (25% of RF) (cum/yr)		90,000
RWH potential at HH level (50% of RF roofs) cum/yr)		9,563
RWH utilisable at 4 cum/hh and two fillings/yr		6,800

Source: TARU Analysis, 2011

Considering the size and the characteristic of the settlement, the likely natural recharge calculated is about 28,800 m^3. However, shape and extent of the aquifer lying below as well and its connectivity with neighboring region will have their impacts on natural recharge capacity which is possibly on the higher side. The annual consumption in the settlement is about 62 million liters (62,000m^3) based on 40 lpcd and 105,120 cum/yr based on 5 pumps @ 8 lps for 2 hours per day. The first estimate is likely to be near the actual use.

RG Nagar is an urban slum. With waste water being disposed on to the ground year round, urban recharge will also play an important role in augmenting the recharge capacity of the region. Waste water from the settlement, septic tanks, and wastage at the source will contribute in increasing the water recharge[6].

The net deficit in current condition is about between 17,000 cum and about 40,000 cum annually. This alarming situation especially considering the neighboring regions demands due to urbanization. Therefore increasing recharge or import of water from the external sources is necessary to ensure availability of water to the community. Rainwater harvesting is an option without having to depend on external sources.

The household level storage of about 4 cum can meet about 3,400 cum or about 5% of the annual usage with single filling during the rainy season and about 6,800 cum/yr (10% of annual water demand) with two fillings per rainy season. While household level storage can reduce the water related wastage of time, it alone cannot balance the use vs. resource.

The settlement level rainwater harvesting can meet the shortfalls, but it would require preventing pollution and a temporary storage space and recharge bore

[6] Hirata, R. et al. (2006): Urban Hydrogeology in Developing Countries: A Foreseeable Crisis, International Symposium on Groundwater Sustainability (ISGWAS)

wells. Also this system will require annual cleaning and other maintenance.

10.6. Rainwater harvesting options

Presently, average per capita water consumption is of 40 liters. This is much less than the daily requirements prescribed by CPHEEO (135lpcd). The settlement is entirely dependent on the groundwater resources developed by corporation. The population is likely to increase in the community as well as development is taking place in the surrounding region. This will stress the groundwater resources and there is possibility of water table decline. In these circumstances, rainwater harvesting options can complement the available groundwater resources of the community as well improve water availability at household level.

10.7. Household level options:

The effective roof area in the settlement per household is about 250 sqft. If this rainwater is collected by at the household level by suitable roof top harvesting method about 15,750 liters of rainwater can be harvested per household during the monsoon season by considering the following parameters.

Rainwater harvested = Rainfall (900 mm) x Runoff coefficient (0.7 for tin sheets) x Surface area (25m^2)

The water stored will also be consumed on daily basis. If all the available rain water from roof is harvested storage capacity of about 6 cum is necessary if half the household level consumption is met by rainwater (100 lpd) during rainy season. At the end of the monsoon season, about 6 cum of water will be available. Even during the rainy season, there may be periods when the rainwater may not be available. An optimal storage of 4 cum is sufficient considering the possible use of the storage as back up for water short term water scarcity.

10.8. Roof area of the settlement:

The rainwater harvesting in the settlement can be opted at household level as well as community level. The total of roof area of 850 household based on 250sqft unit comes to about 212,500 sqft. A GIS based analysis was attempted to get the total roof area of the settlement. This was done by preparing a map of settlement by referring the satellite imagery (Google Earth). The results are shown in following table.

Table 10-5: Roof Area based on GIS Analysis

Roof Classes (sq.ft.)	Counts	Area (sq.ft.)
<250	181	31,213
250-500	185	66,865
500-750	74	44,808
750-1000	26	22,217
>1000	20	27,239
Total	486	192,342
Total roof area for 850 houses (850 x 250 sqft.)		212,500

Note: Roof Area as per satellite imagery based map (Google Earth, GeoEye Image, 2011)
Source: TARU Analysis, 2011

Table 10-5 shows that 486 polygons are identified in the settlement representing different building footprints. The total roof area based on the GIS analysis is 192,342 sq. ft. whereas the total roof area of 850 houses considering 250 sq ft/hh comes to about 212,500 sqft. The roof areas derived based on the satellite imagery includes the buildings like community toilets which are bigger in sizes, combined households as seen in the imagery.

The roof runoff (70%of rainfall) based on the 212,500 sqft of the roof area comes to about 120,000 cum. However, the workability of this option will require many considerations involving the willingness of the community as well as the availability of the suitable roofs to adopt for the recharging options.

CHAPTER 11: SEWERAGE AND SANITATION

11.1. Toilets and sewerage

Till about a decade ago, there were no toilets and people had to defecate in open areas. This was a concern especially for women, children and elderly people. Women and adolescent girls had to spend about 1- 2 hours. This was affecting their other daily activities. since the settlement had already grown up and the open areas were limited, the women had to spend the early morning hours or late evening hours to use the open areas. During the monsoon season, the situation was worse due to wild growth of grass in an open area and slippery soils as well as possibilities of snake bites. Overall, since other communities were also using the same open area, it used to be a crowded during the morning hours.

After facing these problems for nearly a decade, the community requested local political leaders, IMC official and the collector for community toilet in their locality. After two years they got the first community toilet in the year 1999. The residents felt some relief with the availability of the toilet, but due to limited capacity (12 latrines and four bathrooms) it was not sufficient to meet the demands of nearly 3000 people. Further, there were issues of distance for people living in the other end of the settlement to use the facility. Under "Slum Environment and Sanitation Initiative (SESI)" program in the 2007 the New Sulabh Complex was constructed by UN Habitat, WaterAid, IMC and BGMS. It is managed by the community. Now there are two common toilets in the settlement.

The old community toilet charges 10 Rs. per person/month, which is regularly cleaned. A sweeper visits the toilet daily between 11 to 11.30 AM and there are no issues regarding the cleanliness. But, issue of water availability is an issue for this toilet. The bore well supplying water to this toilet sometimes does not function because of power cuts/motor burnouts or voltage fluctuation. In these circumstances, people are forced use open areas. Even during normal days, people often have to wait for 30-40 minutes. The visitors are charged Rs. 10 for one time use. The electricity bill is paid by IMC and other maintenances are also being taken care of IMC.

The new community toilet used to charge Rs. 10/person/month but now has increased the rate to Rs 30/person/month, Rs. 50 for two persons and 70 Rs./family/month.

Despite of having two community toilets and also the limited household level toilet facility in the community, about 60% of the residents still go for the open defecation.

The reason cited by people is that they are not able to afford to pay for the community toilet and therefore are left with no option except to go in an open area. As per the DFID survey in the community, people are able to afford amenities like mobile phone, TVs, cable connections etc., which cost more every month compared to their community toilet costs. This indicates that their lack of willingness to pay towards the services is due to low value or importance they feel for services like sanitation.

In the same year, BGMS also built about 120 private toilets with septic tanks under Water and Sanitation program financed by UN Habitat. Many of the individual toilets are not in use now. The private toilets are septic tank based and also not yet connected to newly built sewerage system. Many of these septic tanks reportedly filled fully and are back flowing, which has led to their non-usage. It is expected that in future the household toilets will be connected to the new sewerage line which has been laid under the "Utthan" project.

11.2. Storm water drainage/Solid waste disposal

There is lack of proper storm water and waste water drainage in the settlement. Stagnant water pools were observed especially at the common water supply outlets. Temporary channels are dug at several places to dispose the waste water and some of them are cemented near the houses, but a settlement level drainage system is absent, leading to water logging risks. The laying of concrete roads at level higher than the house floors can potentially cause water logging due to poldering effects of roads. The residents reported inundation of up to 1.5 feet in some parts of the settlements.

There is no door to door garbage collection in the settlement. IMC has placed one solid waste disposal bin which is irregularly replaced after it fills up. The residents complained about solid waste accumulating in the settlement and wanted some system to be put in place collection and disposal. However, it is equally valid that people also should make efforts to go to the bin for disposing the waste.

11.3. Health issues

There is an absence of government supported health facility in the community, but 4 private clinics rare present in the settlement. Water born related disease like Diarrhea and Jaundice are commonly reported and one of the doctors reported that nearly one third of cases attended by him are stomach ailments. Dengue and malaria cases are also reported during monsoons. The people do not see the linkage between water quality and stomach ailments.

CHAPTER 12: CONCLUSIONS AND WAYS FORWARD

Rahul Gandhi Nagar is an urban slum with 850 households having good infrastructure facility (Road, Water Supply, Electricity, Sewerage) mostly developed during MPUSP project over last five years. Most of the houses are un-engineered and have tin sheet as predominant roof type. The size of the house is too small about 300 sqft floor area) to provide household level toilets, unless all houses build a two story houses.

The community context analysis of this settlement was carried out for assessing the possibilities of implementing the Conjunctive Water Management (CWM) practices. In order to achieve this, state from total 146 households was used to understand the context. Some data from MPUSP survey carried out in the community (in 2009) has been used to supplement the livelihood and asset situation.

The population in the settlement is displaced from four different places of Indore city i.e. Bajrangnagar, Bamori, Choithram Hospital area and Niranjanpur. The socio-economic context of the community indicates that the major livelihood in the community is daily labor or semi-skilled irregular jobs.

The literacy levels of the population are low and therefore education based livelihood options are very limited. Dependency ratio is mostly high with nearly 50% of the households showing ratio of more than 250%. The asset ownership pattern shows fairly extensive ownership of TVs with cable connection and mobile phones, but very low ownership of motorized vehicles. Mobile phones have become a necessity for managing uncertain livelihoods.

The community is dependent totally on ground water sources as there is no piped water supply. The community is facing the typical water related urban issues in terms of access to water and water quality. There are five bore wells in the community which meet the water requirements of the community. These water supply sources are sufficient to meet current demands, but distribution system is currently inadequate, resulting in nearly about 2 person hours spent each day by the households. The household level sample surveys indicated per capita water consumption ranges between between 20 to 60 lpcd. Some of the water related activities are undertaken at the water supply outlets, and this is a likely reason for lower per capital consumption.

The households have to resort to household level storage, due to overcrowding at the outlets as well as due to frequent power cuts and motor breakdowns. It is very

difficult in houses with floor area of <60 sqft/person. Some of the infrastructure building work is ongoing, including water supply and sewerage line, but they are yet to be operational.

Poor storage facility at household level and lack of awareness regarding water quality- health linkages is an important issue to be addressed. It is hoped that water access will improve once the household level supply is commissioned through the pipelines already laid.

The total demand as well as per capita water consumption needs to be monitored, especially since the household level water supply system will be operational soon and number of private toilets is likely to grow with household level water supply. Also there are concerns regarding decline of water table due to over-extraction in the settlement as well as surrounding areas.

Drainage is poor and open defecation is quite common; the susceptibility of community to waterborne diseases is quite high. Presence of 4 health centers in this community of ~4,000 people indicates high disease burden. The doctors report high incidence of water and vector borne disease cases.

Since this community is expected to grow and new settlements are coming up in the surrounding region, the water table decline will be a major issue in the near future. The groundwater recharge scenario indicates that natural as well as urban recharging occurring in the region is less than the withdrawal. This will stress the existing groundwater resources of the settlement. The intervention of the roof rainwater harvesting like roof water can only meet part of this short fall, but settlement level recharge systems can balance the shortfall between demand and current recharge.

The access and affordability of centralized water supply in the near future is doubtful. Considering these, increasing household level storage capacity, rainwater harvesting, ground water recharge are important needs to build climate change resilience in this community.

Willingness to pay for and manage water related interventions

Over the period of past 10 years RG Nagar settlement has developed in terms of infrastructure. The community has represented their demands to the corporation in the past to avail water as well as community toilet facility. The institutional arrangement available in the community is strengthened by continued intervention by various NGOs and IMC. Community level traditional institutions also exist (traditional festival groups and saving groups) as well as groups catalyzed by the efforts of BGMS and corporation.

One of the residents **Mr. Kasi Ram Lohar** who has actively involved in different development initiatives believes that people are willing to participate in any kind of initiative in the locality for supporting the water related interventions. In the past too they have participated and created similar moves in claiming their rights. He opined that that local people can contribute in terms of manual labor and also monthly fee for water, if practical and fruitful options are proposed that can provide relief from existing water related problems.

Another resident **Mrs. Shakun Polay** is felt that existing water supply cannot be called satisfactory as issues of contamination and hardness of water are still very

pressing and causing diseases in many families (corroborated by water quality tests). She felt that the newly constructed road has damaged the recently laid pipelines and the taps are being re-shifted, causing unnecessary delay for the drinking water supply through the pipeline to be connected with the bore wells.

Mr. Kailash Malviya another local resident who runs a cycle repairing shop, shares similar story and adds some new dimension. According to him, the average person in the locality is fed up with the arrangements to be made for drinking water. Transporting water cans on bicycles and by head loads is a time consuming task affecting their daily livelihoods. He adds that though the people are very poor, they are willing to contribute in order to meet their daily water requirements. He gave an example of people using the community toilet and said if someone can pay Rs. 10 per month for the toilet then why not he she can pay for drinking water?.

One of the Community Volunteer Representative (CVR) **Mrs. Sarita Yadav** who holds a good reputation among the local people as a development leader/ facilitator. She informed that the local people are bit dissatisfied about the amount of water they get and the way they have to access the water sources. According to her, the average resident is not aware of the water quality issues and they continue to suffer from waterborne diseases. The existence of four medical practitioners in that kind of small settlements is a proof for her argument. Generally people complain about the time consumed and the labor required in collecting water from nearby water points but she has something more to add here and that is the cost of the time and energy they spend in water collection. She stressed the need for water harvesting in order to prevent ground water decline.

ANNEXURES

Annex (A): Water Quality Analysis: Rahul Gandhi Nagar study area

Parameter	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
	RG BW	RG BW with SP	RG BW	RG BW	BK BW	BK BW	RG New Basti BW	BK BW*	RG Sulabh Complex	RG House Sample
Conductivity µ Mhos/cm	2296	2290	2590	1855	1613	1531	2015	1854	2388	2365
Hardness mg/l	940	816	888	600	440	220	700	650	920	920
Faecal Coliform MPN/100 ml	<1.8	25	8.3	<1.8	12	<1.8	<1.8	5.6	NA	NA
RG-Rahul Gandhi Nagar, BK-Bajrang Kanakad (nearby community), SP-Stand Post, BW-Bore Well NA-Not Analyzed ** Bajrang Kanakd Panchayat new bore well*										
Water Quality Analyzed at MPCB, Indore										

Annex (B): Administrative Status & Socio-Economic Summary

Administration	IMC
Zone	8
Ward	38
Approximate Area (Ha)	5
No. of Households	850
Family Size (rounded off)	5
Estimated population	4,250
Dependency Ratio	2.5
Max. Education	10+
Average Plot size (ft2)	300
Average Roof size (ft2)	250
Houses (>50%)	Non-Engineered
Roof type (>50%)	Tin Sheet
Institutional Framework	Good

Annex (C): Water Related Important Parameters

Water Dependency	Groundwater
Bore wells (BW) drilled by IMC	5
Presently Functional BW	5 (100%)
Estimated Private BW in & around	2
Any Under Development	3
Scarcity level	Medium
Tanker Dependency (summer)	Low
Available lpcd	44
Average storage capacity at Household level (liters)	450
Water Quality Issue	Low to Medium
Daily consumption (liters)	1,70,000
Annual consumption (cum)	68,255
Annual waste water (cum)	54,604
Actual Required @135lpcd (cum)	2,09,419
Deficit / Surplus (ML/yr.)	-141
Rainwater Harvesting Awareness	Aware

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