SUPPLYING CLEAN WATER TO JAIPUR:

A STUDY OF TWO CURRENT GOVERNMENT PROJECTS

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Spring 2009

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Introduction

Water is arguably the most important natural resource for human development, economic growth, and sustainability of the environment. Access to clean water is the most basic human need for life and health, and without it people cannot survive. Water plays a crucial role in determining where communities settle and how big they will be able to grow. Besides being the "elixir of life," it is also essential for socioeconomic development, agriculture, industry, power generation, and other daily activities.[1] Due to the growing population and the shortage of water around the world, it is said that future wars will be fought over water issues.[2]

Although water is used for many purposes, its most important use is for drinking. Drinking water, after irrigation, is the second largest water sector in terms of volume. Around the world, systems of providing drinking water are under increasing pressure to provide more and more water of better quality. The increasing demand for water is due to the growing population, urbanization, and also a rise in the global standard of living. A higher standard of living corresponds with an increase in water use, and also a demand for a higher quality of water. As water is a finite resource that is difficult and expensive to collect and transport on a mass scale, the supply is not able to keep up with the growing demand. For this reason, water regulation and management is a critical issue to study.

Kofi Annan, former United Nations Secretary-General, says, "Access to water is a fundamental human need and therefore a basic human right."[3] Despite the wide acceptance of the fact that having access to drinking water is a basic right by many international organizations and national governments in theory, in practice water is still not being provided to everyone. The WHO/UNICEF Joint Monitoring Program for Water Supply and Sanitation (JMP) 2008 report states that 884 million people, one-eighth of the world's population, do not have access to safe water.[4] Further, the World Health Organization (WHO) estimates that about 10% of the world

disease burden is preventable by managing water in a better way, and about 62% of this prevention can come from fixing the drinking water and sanitation sectors alone.[5]

India, especially Rajasthan, has more than its share of water problems. Rajasthan is India's largest state, covering about 10% of its total area and housing 5% of the population, but it possesses only about 1.16% of country's water resources.[6] The lack of water to begin with has made the government's task of providing water to its citizens difficult. Poor rainfall and excessive dependence on groundwater, both for irrigation and drinking purposes, along with the over-exploitation of these sources has made the task of providing a safe and potable water supply even more impossible in recent years. However, a Rajasthan High Court order states that, "drinking water is a fundamental right under Article 21[Right to Life] of the constitution and the state is duty bound to provide safe drinking water to every citizen."[7] Therefore, it is important that the limited amount of water Rajasthan has now is managed correctly so that the state can provide clean water to all.

This study analyzes government policies in relation to clean drinking water management in Jaipur and the surrounding area. It focuses on two current policies being implemented by the Public Health and Engineering Department (PHED) in urban and rural areas: the Bisalpur Water Supply Project (BWSP) within the city, and the Rajasthan Integrated Fluoride Mitigation Program (RIFMP) in the villages. It outlines the steps that the government is taking to implement these programs, and analyzes their effectiveness in providing an adequate supply of clean drinking water to the people. Water policy goals, taken from *India's 11th Five-Year Plan*, the *Rajasthan State Water Policy*, and the Planning Commission of India's *Water Policy and Action Plan for 2020: An Alternative*, are used as a standard against which to measure the progress of the two programs. Also, public opinions are used to evaluate both the current water situation and the impacts of these programs.

Methodology

In order to explore and analyze the Bisalpur Water Supply Project in Jaipur and the Rajasthan Integrated Fluoride Mitigation Program in surrounding villages, several different approaches are taken. These different approaches incorporate a variety of perspectives into the overall analysis and attempt to give a voice to all sectors of society.

Although the PHED is a state body, the impact of the two programs studied here is limited to the area around Jaipur. The conclusions drawn, especially for the BSWP, are specific to Jaipur and cannot be applied to other programs or areas without further investigation.

The current important water policy documents for India, and more specifically for Rajasthan, are closely examined to determine what the current water projects should be trying to accomplish. The policies are examined as primary sources and are assumed to be the ideal of what the PHED wants to achieve in terms of water policy improvements. While these documents are important, it is important to remember their greater context: they are not specific to Jaipur and therefore not all goals are applicable to the programs being studied here.

To better understand and assess these two programs, a number of people are consulted. Government officials are interviewed and government documents are examined to get a sense of what these two programs are trying to do and who they aim to help. A survey, in both English and Hindi, is used as a guide to interview people from various parts of Jaipur about drinking water within the city. Because the people surveyed cannot be assumed to be an accurate representation of the population of Jaipur, the results are not quantified. However, as an effort was made to collect a random sample from many different areas, the views expressed are believed to be common sentiments and can therefore be used to qualitatively analyze the programs and policies of the government.

Clean Water

For the purpose of this study, clean water is defined as water free of bacteria and chemicals, including fluoride, iron, manganese, salinity, arsenic, nitrates, and pesticides, at levels above the prescribed World Health Organization limits for India. Clean water may come from natural sources, or it may be chemically treated on a government or individual level. However, not all treated or filtered water is clean. For example, although boiling water kills the bacteria and makes it "clean," it does not get rid of chemicals in the water and therefore does not necessarily make it safe to drink. Clean and safe are synonymous in this study, and water must have acceptable limits of all the aforementioned chemicals in order to be considered clean.

Water Policy

According to the Indian Constitution, states are responsible for the water supply to the people in each state's jurisdiction.[8] In Rajasthan, the Public Health and Engineering Department is mainly responsible for water supply and sanitation services. The city government in Jaipur does not have its own office to deal with these issues, however, by necessity different water programs are implemented by the PHED for different cities around the state. Therefore, the drinking water improvement programs in Jaipur may vary greatly from those in Udaipur or Jodhpur, for example, even though both are run by the PHED. Also, water policy in India falls under two categories: urban and rural. Because of the different water supplies and current standards in urban and rural areas, India has come up with different policy goals for each sector.

Although the logistics of water supply are left to the state, the Government of India (GOI) monitors and helps fund the water programs within each state. Further, the GOI sets national standards which the states are expected to reach. One of the ways these standards, or policy

goals, are updated is through the GOI's Five-Year Plans. Developed by the Planning Commission, the Five-Year Plans state the country's goals in different areas, including water, for the next five years, and contain general steps outlining how to achieve these goals. The current five-year plan is the *Eleventh Five-Year Plan, 2007-2012*. The *Report of the Working Group on Water Resources for the XI Five-Year Plan (2007-2012)* states that, "The NWP [National Water Policy of 2002] defines water as a prime natural resource, a basic human need and a precious national asset, to be planned, developed, conserved and managed in an integrated and environmentally sound basis, keeping in view the socio-economic aspects and the needs of the States."[9] Also, it prioritizes drinking water over all other water uses and says that there is a need to re-evaluate the emphasis on groundwater sources that was previously encouraged.

This plan divides the issue of drinking water into two parts: urban and rural. It states that it aims "to provide 100% water supply accessibility to the entire urban population by the end of the Eleventh Plan in 2012."[10] Although this realistically is not an achievable goal, it shows that the GOI is serious about making major improvements in water supply throughout the country. The problem is, however, that the success of these programs, whether they are funded by the GOI or not, is dependent on the state governments' abilities to restructure the water supply or find new sources of water. This is a difficult task, especially for desert states such as Rajasthan. Other stated policy goals for urban areas include making drinking water the topmost priority everywhere and making the metering of piped water mandatory to reduce government costs. Finally, water quality testing laboratories should be set up in every city to control water-borne disease and ensure good quality water is provided to residents.

In terms of the rural water supply, the *Eleventh Five-Year Plan* aims "to provide clean drinking water for all by 2009."[11] Although on the whole states are doing well in providing water to more and more rural populations, the only available water sources are often of poor quality

and unreliable. In order to improve this, the GOI says that it is important to focus on local participation and education of communities to make sure that kits to test and purify water are used properly without constant support from the government.

The *Water Policy and Action Plan for India 2020: An Alternative* was written in 2002 by the National Water Resources Council along with the Prime Minister. It puts forward broad goals for the country, but notes that individual states need to make their own, doable plans as well because the water and monetary resources across the country vary greatly. This policy includes some significant elements not mentioned in the *Eleventh Five-Year Plan* that are important to consider. First, it says, "Besides taking care of urban and rural needs, maintaining the life of river systems and other water bodies should be an important objective of planning."[12] Also, it clearly references that the states are not all the same and should not be treated as such: "The standard with regard to water allocation per capita for domestic use should be 30 to 60 liters per day. It may vary according to rainfall zones i.e. less in Rajasthan and more in Assam, but should be the same for rural and urban areas."[13] This is important not only because it differentiates between states, but also because it says that all people within the state should be treated equally with regard to water supply. Generally, rural areas are allocated less water than urban areas per capita and must accept a lower level of quality, and this should not be the case. Finally, this plan outlines the steps that should be taken to compensate people in the case of forced resettlement due to large water projects. It says that land for land compensation should always be the preferable option, and that rehabilitation should also be provided.

Finally, the *Rajasthan State Water Policy* outlines a framework for the efficient management and sustainability of water resources. This policy is important because it is written with Rajasthan's water resource situation specifically in mind. However, it does not include dates by which the state should accomplish these goals like the other two policies. This is

problematic in terms of actually getting things done. The *Rajasthan State Water Policy* aims to encourage water conservation and to explore new water sources. It also aims to provide "adequate drinking water facilities to the entire population both in urban and rural areas."[14] In order to do these things, the state intends to raise rates for water from individual pipelines, introduce water saving devices, and start educational campaigns about conservation and quality.

Clean Water Supply in Jaipur

Background

As early as 1727 AD when the city of Jaipur was founded, water supply schemes were used by the government to supply Jaipur with water throughout the year. The first of these methods were large public wells called *jhalaras* constructed in each section of the city.[15] Since then, the technology to supply water to residents has become more advanced. Public wells changed to taps, and shared taps eventually gave way to private pipelines for much of the city. Drinking water was separated from irrigation water, and the system continued to expand to meet the increasing demands of the growing city. As the population continued to increase, however, it became apparent that the local water supply would no longer be sufficient to provide the people with enough water, and projects from distant water sources were started.

Sawai Man Singh II built Ramgarh Lake to supply water to Jaipur in the 1920s when it became clear that the city did not have enough water. For many years, the lake was the main source of drinking water for the entire city. Water was piped 40 kilometers (km) to reach Jaipur, and the system was able to provide more reliable quantities of clean water than before. However, due to the increasing demand for water, poor management, and unsatisfactory monsoon seasons, the lake ceased to be a sufficient water source, and today is almost dry. For the last 30 years, the government has been installing bore wells in Jaipur to get the additional needed water to the

people. Currently, about 1700 bore wells have been sunk in the city, and 97% of Jaipur's water supply comes from groundwater.[16] The high volume of use has surpassed the recharge capacity of the groundwater, and the groundwater table levels are falling at alarming rates of up to three meters per year. As the groundwater levels fall, the bore wells are going dry and need to be drilled deeper to provide water. This is problematic because water from deeper in the earth has higher concentrations of chemicals and minerals that are harmful to human health. Also, water from bore wells has unsafe nitrate levels due to contamination from the poor sewage system in the city. In some areas, nitrate levels are so high that the water is un-potable.[17] This is why many people in Jaipur suffer from severe diarrhea and other water-related illnesses. Further, most areas of the city only have a water supply for an hour or two a day. Many middle and upper class residents have tanks to store water later use, but this is a luxury not affordable for the poor. Without a change in the water supply, the city would face a severe water crisis by 2012, although for many the situation is already dire.

Due to the falling groundwater levels, poor quality, and the inadequate supply, there was a great need to find a new surface water source that would fix these issues. The goal was to find a water supply that would be able to provide the entire city with 24-hour clean water service and be able to accommodate the projected growth rate in Jaipur for future years as well.

Bisalpur Water Supply Project

The foundation for the Bisalpur Water Supply Project was laid almost 15 years ago in 1995 by Chief Minister Ashok Gehlot, but it was not until March 2009 that the project first showed signs of success in the city of Jaipur. In these years, a dam near Bisalpur Village was constructed and pipeline was laid in order to fix the looming water shortage problems in Jaipur.

The Bisalpur project is a multipurpose project with two main functions. The first is to provide drinking water to Jaipur, and the second is to provide water for irrigation to areas in Tonk district. The Bisalpur Dam, built on the Banas River near Bisalpur Village in Tonk District, Rajasthan, is about 120 kilometers from Jaipur and is providing all the water for these two projects. The dam is 574 meters long and 39.5 meters high, and it can store up to 38.70 thousand million cubic meters (TMC) of water.[18] Out of this, the Central Water Commission in New Delhi has declared that 33.15 TMC of water is available with 75% reliability, and taking into account evaporation and other losses, the net amount of usable water that has been allocated for drinking and irrigation is 24.2 TMC.

Of this total amount, 11.1 TMC has been allotted to Jaipur, Tonk, and enroute villages for drinking water. An additional 5.1 TMC is for drinking water in Ajmer, Beawar, Kishangarh, Kekri, and nearby villages. Finally, the remaining 8.0 TMC is for the irrigation of approximately 81800 hectares (ha) of land in Tonk, Todaraisingh, Uniyara, and Deoli Tehsil.[19] This study focuses only on the part of the Bisalpur Project that supplies Jaipur with drinking water.

The requirements for drinking water in Jaipur have been estimated as being 4.8 TMC in 2001, 7.6 TMC in 2011, and 11.1 TMC in 2021.[20] Therefore, this water supply should be more than adequate until 2021, when the supply and demand is estimated to be the same. After 2021, demand will be higher than the renewable supply from the dam alone, and it will cease to be a sustainable water source. Current projections indicate that by 2027, the water supply will have been seriously depleted, and Bisalpur Dam will no longer be able to supply the majority of the water that Jaipur needs.[21] However, this amount of time is thought to be sufficient enough to allow the groundwater levels to recharge and to explore other water options.

Stage I of the Bisalpur Water Supply Project in Jaipur is divided into two phases. Phase I, currently in progress, includes building the new water treatment plant and installing enough

pipeline and pumps to supply the city with 360 million liters daily (MLD) of clean water. Phase II will expand this amount to 540 MLD. This is projected to be sufficient until the year 2016. After that, Stage II will begin to increase the capacity of the supply to Jaipur up to 869 MLD. The BWSP is being funded by the Asian Development Bank (ADB), the Japanese Bank for International Cooperation (JBIC), and the Government of Rajasthan (GOR). The ADB has loaned the government $60 million, approximately half the cost of Phase I of the project. JBIC has agreed to loan the state $85 million, about three-fourths of the cost of the second phase.

The water treatment plant for Bisalpur water is located in Suraipura Village, near the Bisalpur Dam. It contains a clean water reservoir and pumping station, and has the technology to thoroughly clean and monitor the water. This technology is aimed at controlling quality. The government is using a system called Supervisory Control Data Acquisition (SCAD) that allows engineers to maintain the desired level of quality and quantity at all times. The system also allows the PHED to quickly locate and fix problems anywhere within the system. Superintending engineer Subodh Jain of the PHED says that this technology also, "enables us to maintain the flow rate, chlorine level, and alkalinity of the water. The water will be the cleanest the city has ever seen, as good as bottled water sold in the market."[22] Baring any major problems, he says that many Jaipurites will see a huge change in the quality of their water in the coming months.

Adverse Effects and Displaced People

Although the Bisalpur Water Supply Project is supposed to benefit far over a million people, there are some negative effects as well. In creating the Bisalpur Dam, 63 villages and about 30,000 people were adversely affected by the submergence of their land. Further, a small number of people were forced to give their land to the government in order to build the water treatment plant and install a small amount of pipeline. Although the locations of the water

treatment plant and the pipeline were selected in order to displace the fewest number of people, it was impossible to avoid completely. The Government of Rajasthan is compensating these people for their losses, but of course compensation is never an ideal solution.[23] Land is a means of livelihood, whereas cash compensation will only last a short time. Also, nothing can make up for the loss of a personal connection with the land one has always lived on.

The Rajasthan Urban Infrastructure Development Project (RUIDP) has identified several positive effects for people disrupted by the dam and BWSP. These include receiving a new supply of potable water, increased employment opportunities through government jobs, improved roads and infrastructure to villages, and better transport facilities. All of these benefits are expected to help provide a healthier, higher quality of life. However, there are many negative effects that may outweigh the positive ones. These include loss or decrease of yield of agricultural land, loss of houses, wells, common pasture land and trees, and resettlement time.

To make up for these losses, mitigation measures have been put into place. The GOR's goal is "to ensure that no project-affected person shall be worse off than he or she was before the project."[24] In addition to receiving compensation for displacement, affected people also are compensated for structures and other lost assets, transport costs to new locations, and potential income loss during the transition time. Also, short and long term employment opportunities through the BWSP are offered to affected people when available. The GOR found that a majority of people said that they would prefer cash compensation to compensation in the form of land when surveyed.[25] However, the *Water Policy and Action Plan for India 2020* says that land for land compensation is always preferable because it enables families to generate income whereas cash quickly disappears, leaving them without a means of livelihood if they do not spend it properly. For many poor villagers, an offer of a large sum of cash seems enticing because they have never had that much money. However, they do not know how to manage it and are soon

much worse off because they spend the money irresponsibly. According to PHED Engineer S. Bhakar in Tonk, the government prefers cash compensation because it is easier than giving land. However, there are not enough resources available to help these people use their money in a constructive way to start a new life.[26]

The GOR must carefully consider their mitigation measures. Cash compensation needs to be accompanied by aid to help families buy land and manage money. The goal of ensuring that no one is worse off because of the BWSP should not just apply to right now, but to future years as well. Although cash compensation seems good now, without help many families will struggle down the line as they run out of money and realize that their means of livelihood is gone.

Reactions of the People

As can be expected, despite the attempts of the government to mitigate the affected people, not all are happy with their forced decision to completely change their lives. Farmers living near the Bisalpur Dam noticed after its construction that they had less and less water every year to grow their crops. Despite the dam destroying their means of livelihood, the government refused to listen to their pleas to get water diverted from the dam for irrigation because it is all needed in Jaipur. In 2005, these farmers decided to protest. Several people were shot and killed by authorities, but they never got the water they wanted.[27] Although this was several years ago, it shows the unfortunate effects of the choices the government must make when it comes to water policy. More importantly, it also highlights the voices of those that the government ignores.

It is clear that the Bisalpur Water Supply Project is hurting many rural villagers who live near the dam. But what about the 2.5 million people living in Jaipur? According to basic economic theory, the benefits to society must outweigh the project's costs to society. The BWSP is supposed to provide cleaner water for considerably longer periods of time per day to all of

Jaipur. However, the perceptions and opinions people have about the project differ widely around the city. It is just as important to hear the voices of these residents as it is to hear the voices of the forgotten farmers near Bisalpur.

Twenty-five people from different areas around Jaipur were either interviewed in English or given a survey to fill out in Hindi. The survey questions, which are roughly the same in both languages, can be seen in Appendix 1. Participants were asked about their current water access and their opinions about the Bisalpur project. Despite the frustrations over the delay in providing the water, for the most part Jaipurites are excited about the BWSP and think that it will make a big difference for the city in terms of improving water supply and quality.

Most people surveyed have private taps in their homes; however they only have water for an average of one to two hours a day. While most were able to pinpoint the time water came to their house each day, several described it as being irregular and unpredictable. Anil Sann, who lives near Amer Road in Nigam Nagar Colony, says of his colony, "Correct water supply times are not given. Only dirty water comes, and some days the water does not come at all."[28] Sann has a tank in his house to collect water, and his neighborhood also has a communal tank that fills up to help families who cannot afford their own. However this water is dirty and often makes people sick. On the other hand, Mosin Khan, who lives on MI Road, does not have a tank to collect water. Every morning, his wife manually fills pots with water to use for cooking and cleaning throughout the day. If she misses the time when the water is on, it is very difficult for her to obtain it.[29]

The opinions about current water quality in Jaipur are highly varied. Several people describe their water quality as good, and do not feel the need to purify it in any way. Others say that their water is of good quality, but they still use a purifying system before drinking it. In response to a question about water quality, Shirish Kuman Sharma of Khora Bisal says, "Our

water comes completely clean." However, when asked whether or not he purifies his drinking water, he says, "Yes, we clean our water also. In our house we put it through a purification system."[30] Although these statements seem contradictory, Sharma and others believe that while the water in Jaipur is not completely clean or safe to drink, it is much better than the water quality in other areas, and therefore consider it to be relatively good. However, not all are happy with the water. Several people state that they wish water came for more hours a day, especially during the summer. Others admit that while their water quality is acceptable, they know of people who get unclean water. Interestingly, the quality of the water coming to homes does not seem to be a main concern. This is because most people purify their drinking and cooking water in some way, either with a chemical water purifier or by boiling it. Although they are mostly protected while in their homes, they cite consuming outside water as a means of getting sick. Shekar Shivahare of C-Scheme says, "The main cause of diarrhea is bad water. In the summer the bacteria can grow too fast so the problem is even worse. When we go out, we always take water with us. This way we know it is safe. Or we drink only bottled or hot drinks. You must be very careful so you do not get sick from the water."[31] Even if all the water in the city was purified before coming through the tap, Neeta Singh of Raja Park says that Jaipurites would still have to be careful about what they consume outside. She says, "In the summer when it is hot, the water grows bacteria quickly and even water that seems clean can be dangerous. Also, any open source of liquid is exposed to the pollutants and dust in the air which can contaminate it."[32]

Although the government is not providing an adequate water supply right now, many people believe the PHED is working hard to fix the problem. However, others call the government corrupt and lazy, and do not think they care about providing water to the poor and underrepresented. Bharat Ramchandani of Malviya Nagar says, "The government is very, very greedy and very careless. They only know how to get one thing: money and more money."[33]

Also, it is largely accepted that there is great inequity when it comes to water supply and quality around the city. Ranjeev Mathur of Panipech says, "The government should be concerned with working in particular areas like Chandpol so that people can access water everywhere."[34] He says that they are still a long way off their target of providing water to the whole city. Others are concerned with the fact that water access appears to be correlated with power. Water in Civil Lines, where important politicians live, is thought to be considerably better than a few kilometers away in Bapu Nagar, for example. Finally, the supply of water is not long enough. Many believe that the government needs to provide water for longer periods of time each day, with the ultimate goal being 24 hours a day.

People recognize the Bisalpur Water Supply Project as a government project trying to do this. Although it is not complete, the BWSP is seen as a step in the right direction for the government, and most people expect to benefit from this project eventually. Although the water was supposed to be supplying a large portion of the city by March, the project is behind schedule. Currently, the only areas that have seen Bisalpur water are Malviya Nagar and Mansarovar. Parts of the Walled City were supposed to be first in line for water, but complications in laying the pipeline mean that it probably will not benefit from the project for another two months. By September 2009, most of the city should be getting Bisalpur water if no more complications arise. In Malviya Nagar, Ramchandani says that his water quality has greatly improved and that the new water is "very purified."[35] He knows that it is coming for a longer period of time than it used to, but is not sure by how much. Archana Mathur, also of Malviya Nagar is disappointed that the water is not coming to her house for any longer than it used to, nor is the pressure better. She says, "They promise us that this will change soon, but I do not know what to believe, because they keep saying 'soon' but it never happens."[36] Mathur does admit that the water seems cleaner and tastes better than before, though, so she is still hopeful that the

Bisalpur Project will be the answer to Jaipur's water problems. PHED officials say that the narrow old pipelines in neighborhoods like hers are preventing a better flow right now, but that it will continue to be improved. Although it will take several years, eventually the whole city will have water access for close to 24 hours a day.

Although it has not started for most people, the Bisalpur Water Supply Project is viewed by residents as good solution to the drinking water problem in Jaipur, at least for now. They cite the expected improvements in quality and supply time as the main reasons for this, and several people say, "Now all of Jaipur will be supplied with water."

Not all of Jaipur is expected to be supplied with water, however, at least in the next couple of years. Archenna Agarwal of Satya, An NGO, explains about the situation in Kunda Basti, which is located on the East edge of Jaipur: "This basti is an example of where the PHED is failing. They do not have any individual pipelines, and now that the hand pumps are drying up, have to rely on tanks of water being brought in. Because they do not already have pipeline in the area, there are no plans for them to get Bisalpur water anytime soon."[37] Interestingly, she says that the women she works with do not want to pay for water in private connections, even though they spend up to several hours each day collecting water. They feel that because they can get water for free, their money is better spent on electricity or household items.

In addition to those who will not benefit at all, other problems with this project are identified by residents. Rama Mathur, who lives on JLN Marg, is worried about what will happen in twenty years. She says that the BWSP is an excellent solution for right now but it will make people even more reliant on water and the problem will be even more serious when the Bisalpur water runs out. She does not have an ideal solution for Jaipur ("or else I'd be rich!") but thinks that it probably involves teaching conservation measures.[38]

Pricing Structure

Currently, the PHED's water rates for customers with metered private connections follow those shown in Figure 1:[39]

	DOMESTIC RATES	Gross rate per 1000 Liters (Rs.)
	(a) for consumption up to first 15,000 liters	1.56
	(b) for consumption exceeding 15,000 liters and up to 40,000 liters	3.00
	(c) for next consumption above 40,000 liters	4.00
Figure 1		

The rates are divided into three tiers, with small quantities of water being cheaper than additional quantities. This is a form of second degree price discrimination called Increasing Block Pricing (IBP). Increasing Block Pricing is commonly used by governments for sectors such as water and electricity where the essential good is provided at a price cheaper than its actual cost so that it is affordable for everyone. However, additional quantities are considered a luxury as opposed to a necessity so a more accurate price is charged for these units. This pricing scheme also serves to limit the amount of good demanded, because less is demanded when the price is higher.

Figure 2 shows the current IBP pricing. For the first 15,000 liters of water, the consumer pays 1.56 rupees per 1,000 liters. However, for quantities between 15,000 and 40,000, the consumer pays 3 rupees per 1,000 liters, and above 40,000 liters the consumer pays 4 rupees per 1,000 liters. Note that every consumer will pay the lowest price for their first 15,000 liters of water. This pricing scheme is structured so that if the consumer uses 20,000 liters of water, he pays 1.56 rupees per 1,000 liters for 15,000 liters and 3 rupees per 1,000 liters for the additional

5,000 liters. The total price of water is simply the area under the curve. Although not considered here, a twenty percent discount is offered to those who pay their bill on time, so actual prices may be lower than stated here. It is also important to note that people are not charged for water from hand pumps and other non-private connections. There is always a way to access water for free if one cannot afford these small fees, although it is much less convenient. However, some areas in Jaipur, especially the Katchi Bastis on the outskirts of the city, do not have the choice of using water from pipelines because the infrastructure does not reach these neighborhoods.

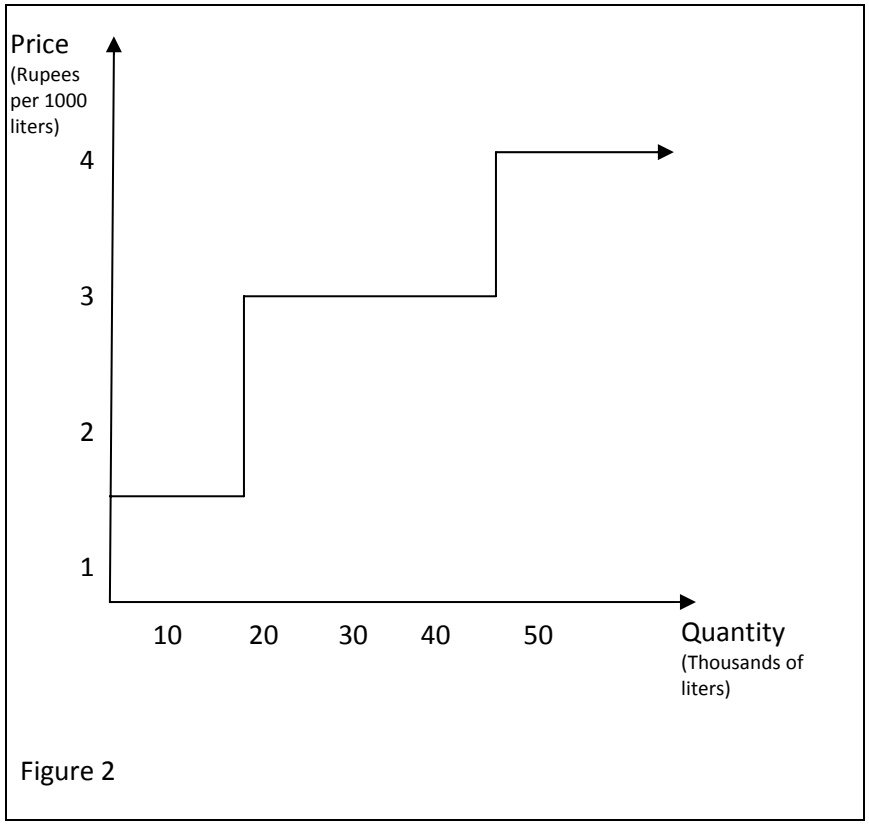

Figure 2

Increasing Block Pricing is the ideal pricing structure for an essential good such as water. The lowest price is below the marginal cost per unit so that it is more affordable than the fair market price should be. However, the higher prices for higher quantities can more accurately reflect the true cost of providing the good and even help recoup some of the losses incurred by the government in providing lesser quantities cheaply. Because of the lower demand for higher

quantities, the increasing prices are not expected to cover the losses of providing cheap water, but instead to make people appreciate the value of water and to bring enough revenue in to allow the government to continue improving the system.

Because the Bisalpur Water Supply Project is more expensive than the current water supply system, the pricing structure of water needs to be updated in order to make up for the additional losses the government will incur. Several alternative pricing structures have been suggested. The most common is an income based pricing scheme. Although this would solve the problem of making the price of water too expensive for the poor, there are fairness issues that should be considered. If water is a basic right, it is unfair to charge some people more than others for the same quantity and quality. Also, income based pricing is hard to track. It is easy to cheat or get cheated by the system since incomes and family sizes are constantly changing. This pricing structure takes too much monitoring to be feasible for Jaipur. Another suggestion is fixed rate pricing, which charges each consumer a flat rate every month regardless of usage. The advantages to this system are that it is easy to control the amount of revenue that will be collected each period and it requires little monitoring. The PHED currently uses a modified version of fixed rate pricing. Depending on the size of one's individual connection pipeline, there is a minimum monthly charge regardless of how much water is used. The problem with this is that it encourages waste. Mr. R. C. Bhargava of Civil Lines says that he pays this fixed amount every month because his household never uses more water than this.[40] His family has no incentive to conserve water because they will not save money by doing so. Therefore, the problem with this pricing system is not the amount of revenue it creates but instead the fact that it is not working to change the consumption habits of Jaipurites. Because Jaipur will always face water shortage concerns, it is important that the government focuses on shifting the demand for water as well as the supply.

Therefore, the PHED should maintain the IBP pricing structure, but the rates need to be updated in order to reflect the higher costs of the BWSP. Although the government plans to raise rates in the future, there are currently no concrete plans on what these increases will be. According to R. R. Sharma, the lowest rate is not expected to rise substantially, although the higher price tiers might.[41] The quantity divisions should also be reconsidered. The *Water Policy and Action Plan for India 2020* says that water allocation for domestic use should be 30-60 liters per day per capita. Using the upper limit and an average family size of six, a typical family should be allocated about 12,600 liters of water per month. Changing the first price's upper limit to reflect this would increase revenues without making necessary amounts of water unaffordable. Lowering the upper limit of the second price tier and substantially raising the prices of the second and third tier quantities are other easy ways of raising revenues without jeopardizing the people's right to drinking water. Also, the PHED needs to ensure that meters are working and are monitored properly so the money that should be coming in actually does. Right now, a significant amount of potential revenue is lost because this is not done. Doing so falls under the requirements of both the *Eleventh Five Year Plan* and the *Rajasthan State Water Policy*, and would enable the PHED to put additional revenue back into further improving the water system.

Environment

The Bisalpur Water Supply Project takes all of its water from the Banas River. However, the Banas River is not a perennial river and relies on the annual monsoon to replenish it. Without good monsoon seasons, the water supply will not be sufficient for Jaipur for as long as the PHED is hoping. Even with average monsoons, this is only supposed to be until 2021.

Building dams has severe consequences on the environment. The collection of water in a man-made, confined area submerges the land in some areas and constricts the amount of water

available further down the line. Besides the negative consequences for farmers and other people who used to have access to this water, there are serious implications for the environment as well. Entire ecosystems are disrupted by the changing course of a waterway, and building a dam only multiplies these effects. When water collects, the ground is unable to absorb it and use it to nourish plants. Often, as in this case, while detrimental effects to humans are considered, environmental consequences are considered a necessary sacrifice. It is acceptable to destroy or alter ecosystems in order to benefit human being. This is not always bad: it allows us to have cities, constant water supplies, electricity, and other comforts. However, as seen with the ground water crisis in Jaipur, destroying the environment ultimately comes back to hurt us.

The BWSP is not environmentally friendly. The river flow has been affected, and the river will cease to exist in a mere twenty years. Minimum water flows are not being maintained, nor are there safeguards in place to protect the environment around the dam and water treatment plant. In addition, the constant pollution from these sources and the residual chemicals from cleaning the water are harmful to nearby wildlife as well as humans. The *Water Policy and Action Plan for India 2020* says that environmental protection should be an important part of planning, including "maintaining minimum water flows, prevention of pollution from industry and agriculture and control of riverbed sand extraction to ensure the maintenance of aquatic life and other ecological factors."[42] The BWSP is not doing any of these things. While this project cannot be faulted for having an adverse environmental impact when so many others do as well, the lack of planning to make the project sustainable, or at least more sustainable than it is, can.

The BWSP is not supposed to be a long term solution. Instead, it is supposed to supply Jaipur with water for a long enough time to allow the ground water levels to recharge and to explore new options for providing the city with water. From the point of view of ground water experts, this project is good for the environment in some ways because it is taking the pressure

off the ground water and giving it a chance to return to natural levels. The poor quality and increasingly limited supply of groundwater does not just affect humans, but animals and plants as well.

However, if the water supply system returns to groundwater in twenty years, the water levels are just going to start falling again at an even faster rate. To avoid this, the government needs to seriously start working on sustainable solutions to the water supply problem. Many local NGOs such as Satya, An NGO (Satya), Health, Environment and Development Consortium (HEDCON), and Center for Community Economics and Development Consultants Society (CECOEDECON), recommend the use of rain water harvesting systems to help recharge groundwater levels. Since June 2000, the GOR has made the collection of rainwater compulsory for all public buildings and properties of more than 500 square meters in urban areas. However, Vikram Singh, Assistant to the Chief Minister, says, "Even though rain water harvesting is technically mandated, there is no enforcement of the law. New buildings are constructed without a means of harvesting water."[43] Rainwater harvesting is relatively easy and can be done in both rural and urban areas. Rainwater is collected and either stored to be used throughout the year or directed into the ground to help recharge groundwater levels. Dr. Prakash Tyagi of HEDCON says, "There is an urgent need in developing water harvesting techniques in Jaipur and all over India. Less than ten percent of potential water harvesting sites are being utilized in Rajasthan, and the water levels are continuing to fall at an alarming pace."[44] Rainwater harvesting is easy and environmentally friendly. The government should enforce the rainwater harvesting law and also encourage others to install harvesting devices. Although rainwater alone will not supply the city with enough water, it will go a long way in reducing the demand from other sources and protecting the environment as much as possible.

Policy Analysis

The Bisalpur Water Supply Project is necessary to the development of Jaipur. Without this water source, the city would not be able to grow in coming years, and current residents would suffer from the lack of water. Jaipur needed a large water source relatively fast, and that is exactly what the BWSP is providing. Although it has some problems, the project is good overall for the city, and is viewed positively by most residents.

The main problem with the BWSP is that it is not sustainable. Millions of dollars are being invested into infrastructure that will be partially unusable in twenty years. On top of this, destroying the Banas River will adversely affect many areas in Rajasthan as well as the people in those areas. The displacement policy is not perfect either, but at least compensation is happening in a timely manner.

The BWSP goes a long way in helping to reach the water policy goals that have been set out for Rajasthan in Jaipur. While not everyone in Jaipur will get Bisalpur water, the project is putting the government significantly closer to their goal of providing everyone with clean water. The water will be of topmost quality, and greatly reduce water-related illness in Jaipur. Also, as seen in the allocation of the Bisalpur water to Jaipur instead of the farmers, drinking water is the top priority for the government.

The biggest problem is not the BWSP itself, which is certainly good for the city right now, but the lack of other programs to go along with it. The government should start promoting conservation measures and education immediately. In addition to making rainwater harvesting mandatory, they should be educating children in schools about the importance of conserving water and exploring other ways to reduce demand. Rajasthan will probably never have enough water, and finding an adequate supply will always be an issue. Therefore, reducing the demand for water is essential, and it is important that the government starts to do so immediately.

Because it seems unlikely that any one source of water will ever be enough for Jaipur, whether it is surface water, groundwater, or rainwater, it is important for the government to take a multi-faceted approach to solving the water problem. The BWSP, along with education and conservation programs, rainwater harvesting and a reduced amount of groundwater usage, could potentially lessen the demand on any one water source enough to make all of them sustainable and provide a sufficient amount of clean drinking water to the residents of Jaipur.

Clean Water in Rural Areas

Fluoride Problems

The Rajasthan government has drilled over 250,000 holes into the earth to extract water through hand pumps. Every year, approximately 15,000 new places in rural areas are drilled as the answer to the rural water problem.[45] However, this solution might not be the best answer to the drinking water supply in rural areas. The levels of groundwater in the areas outside Jaipur are dropping at a rate of 1-3 meters per year. The ground water levels reflect that most areas are over-exploited, and the government has to drill deeper and deeper to get a reliable water supply to the villages when installing hand pumps. Again, drilling deeper extracts water from further within the earth, which contains more minerals and chemicals than water closer to the surface does. High levels of fluorides and nitrates, two of the most common chemicals in Rajasthan, are extremely dangerous. Fluoride in concentrations higher than the commonly accepted levels leads to dental, skeletal, and muscular fluorosis. While mild fluorosis is associated with a cosmetic discoloration of teeth, more serious cases can be deadly.

According to the World Health Organization, fluoride levels of up to 0.6 parts per million (ppm) are beneficial to bone and teeth development, and 1.5 ppm is the upper limit of what is considered to be safe.[46] Fluoride levels higher than this put people at risk for fluorosis. Dental

fluorosis varies from a mild cosmetic discoloration to actual destruction of the tooth. Skeletal and muscular fluorosis are much more serious. They cause, among other things, severe joint pain, deformed limbs, osteosclerosis, calcification of ligaments and tendons, paralysis, muscular wasting, and premature aging. Non-skeletal fluorosis causes nervousness, depression, kidney problems, and gastro-intestinal problems such as acute abdominal pain, diarrhea, and nausea. Finally, research has shown consumption of high levels of fluoride to lead to thyroid problems and various types of cancer, but these connections are still being studied.

Rajasthan Integrated Fluoride Mitigation Program

In an effort to provide safe water to rural areas, the Government of Rajasthan, through the Public Health Engineering Department in Jaipur, is working on the Rajasthan Integrated Fluoride Mitigation Program (RIFMP). This program aims to reduce dangerously high fluoride levels in the drinking water in rural parts of the state. Through chemical analysis of drinking water sources, the PHED has identified approximately 23,000 villages with unsafe fluoride levels in their water to benefit from this program.

The Rajasthan Integrated Fluoride Mitigation Program, although organized and funded by the government, is implemented mainly by Non-Government Organizations (NGOs) that have established relationships with the village communities. This is because the program aims not only to treat the drinking water, but also to educate the communities on why it is important to do so. NGOs have the time and personnel available to go into the villages and work closely with the people to ensure that this is accomplished whereas the government does not.

The government is supplying Domestic Defluoridation Units (DDFUs) to families below the poverty line (BPL) free of cost. Families above the poverty line (APL) are encouraged to buy the units from the government at a subsidized cost, but are not provided with them for free. It is

important to note that the DDFUs only remove fluoride from the water. Because other chemicals may still be present at high levels, the water is not necessarily clean as the term is defined in this paper. However, because high fluoride levels are the biggest water problem in most rural areas, the GOR has decided that this method of treating the water is sufficient for now.

This program is divided into three phases based on the fluoride levels found in the water. Phase I, which supplied DDFUs to villages with fluoride levels greater than 5 milligrams per liter (mg/l), has been completed. The government is currently in the process of completing Phase II, for villages with fluoride levels between 3 and 5 mg/l. Phase III will supply DDFUs to villages with fluoride levels between 1.5 and 3 mg/l, and is expected to start early next year.

Fluoride cannot be removed from water by boiling it, meaning that unless the water is chemically treated, there is no way to make it safe. Activated Alumina filters and Reverse Osmosis are the only ways to remove fluoride from water. All of the aforementioned problems related to fluorosis can easily be avoided by using Activated Alumina filters such as the ones in the DDFUs that the PHED is providing to villagers. The problem is convincing the people of the importance of using the filters, and more importantly, convincing them to continue to use the filters once they are no longer provided by the government for free.

DDFUs work by channeling water through an Activated Alumina filter to remove the fluoride before it is used. Figure 3 shows the components of a standard DDFU.[47] The water is put in at the top, and the clean water comes out from the tap at the bottom. The DDFU consists of two large chambers, the top for raw water and the bottom for clean water. In between is the Activated Alumina filter. The water is filtered at a rate of about 8-10 liters per hour, so it is not a fast process. This is why it is not practical to have only one or two DDFUs per village. Every couple of months, depending on usage, the Activated Alumina filters must be regenerated. The process for regenerating the filters is fairly easy; the filters just need to be soaked overnight in a

chemical solution and then are reusable. Regeneration centers are set up and staffed by the NGOs in every few villages. The staff is responsible for monitoring all the DDFUs in their area and regenerating the filters when necessary.

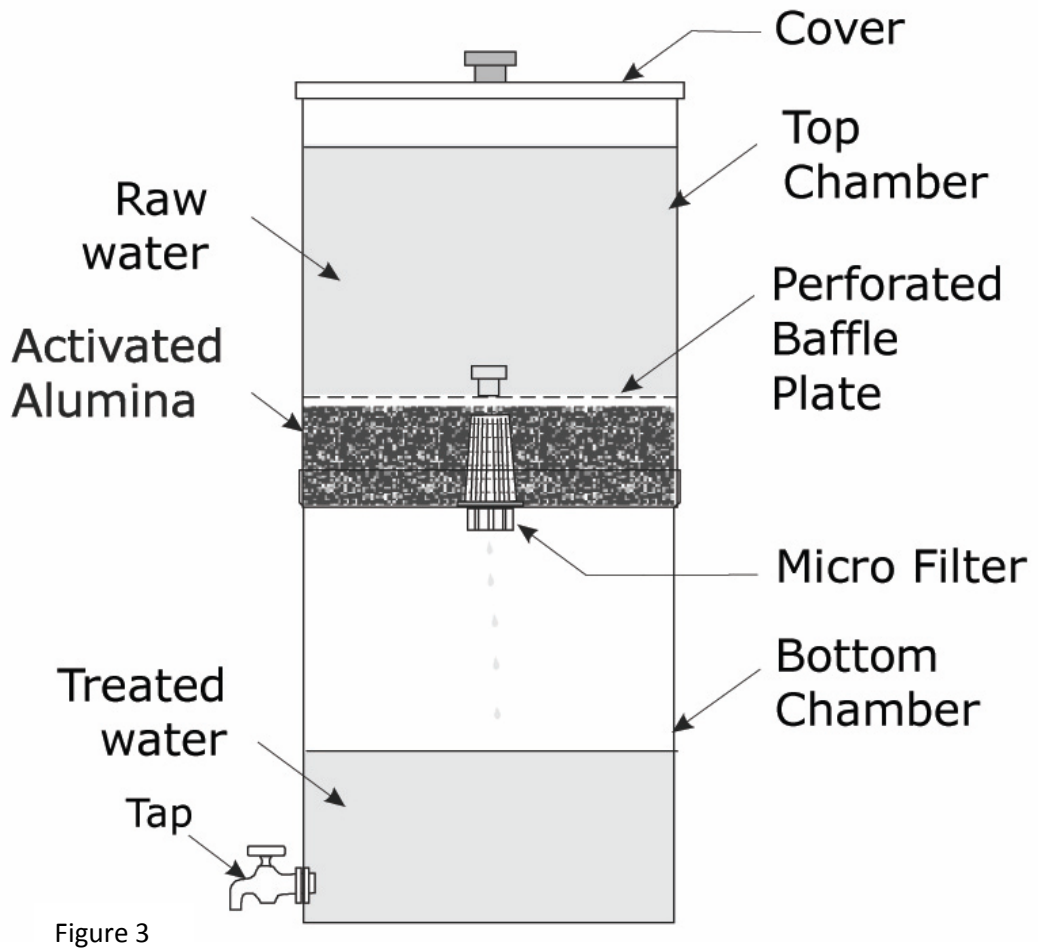

Figure 3

The DDFUs and Activated Alumina filters are not a perfect solution to the rural water quality problem. Firstly, they only remove fluoride, not other chemicals. Therefore the water is not necessarily clean and the government is not fully achieving the policy goal of providing clean water to all. Related to this, these filters leave traces of aluminum in the defluorinated water. Aluminum has been found to be toxic at high levels, and has been linked to Alzheimer's Disease and impaired cognitive and motor function. The WHO states that the acceptable upper

limit for aluminum in drinking water is 0.2 mg/L, which is considerable higher than the trace amounts left by the filters. However, the desirable limit of aluminum in water is less than 0.03 mg/L, which is much closer to the amount present after passing through an Activated Alumina filter.[48] Because of this, the use of Activated Alumina filters must be monitored and further studied to ensure that they are not doing more harm than good. It is unlikely that this is the case, especially since fluorosis has the biggest effect on children during stages of bone development whereas aluminum related problems generally take much longer to surface. However, finding a solution that would provide totally clean water should continue to be explored.

The Surface Water Debate

Before the government started installing hand pumps, villagers relied on surface water sources such as lakes, ponds, rivers, and wells to get their water. These sources were often far away from most homes and inconsistent in the amount of water that they provided throughout the year. Further, surface water is easily contaminable by pollutants, animals, feces, and other things that come into contact with it. For this reason, surface water often harbors many harmful diseases and is responsible for making countless people ill. In order to lessen the risk of such diseases, the Government of India sought to provide ground water sources such as hand pumps and bore wells to rural areas without a regular water supply. This was thought to be a better, more reliable option than the surface water sources. Started in 1991, the Rajiv Gandhi National Drinking Water Mission's objective was to "provide 40 liters of water per capita per day to all habitats which did not have a regular water supply, create awareness about safety and promote community education."[49] Although ground water in rural areas is usually not chemically treated, there is a significantly smaller risk of microbial contamination when it comes directly from the

ground. The downside is that in some regions like Rajasthan, the ground water is contaminated with high levels of chemicals like fluoride, iron, and nitrates.

Today, with groundwater levels rapidly falling and the effects of groundwater chemicals known to have more harmful effects than first thought, some academics and government critics are advocating for the return to surface water sources. The best thing would be to have surface waters treated and piped into all villages like water from Bisalpur Dam is being piped into Jaipur. However, even in Jaipur the water will not reach everybody within the city limits. This solution is highly impractical in terms of costs and efficiency, because most villages are far away from the main pipeline. Deepak Malik of HEDCON in Jaipur believes that the return to traditional surface water sources and intense awareness campaigns sponsored by the government is the right answer. He says, “Changing the source of drinking water, improving the nutritional levels and rainwater harvesting are better options for successfully addressing the fluorosis problem in Rajasthan. Defluoridation should be the last option."[50] Awareness campaigns, whether focusing on how to collect, conserve, and store water in a safe manner or how to treat contaminated water, will definitely play a crucial role in achieving the goal of ensuring that everyone has clean drinking water in coming years. However, it will not solve the problem of providing access to water. Water harvesting techniques should be implemented as they will help stabilize the groundwater levels both in the cities and in rural areas. However, if it does not rain there is no water, nor is there much anyone can do about it. If there is no access to water, it really does not matter whether people have a means to clean it or not. In recent years, Rajasthan has experienced serious drought and there has not been enough rainwater to last the whole year. This is why groundwater sources are also important, even if they are used as a secondary means of getting water. They are more practical and sustainable than bringing tanks of water to villages in times of drought. Of course, it must be noted that hand pumps are not totally reliable either. They

break, and if the groundwater levels get too low, go dry. However, they are still more reliable than rainwater harvesting alone. Like in Jaipur, the best solution for rural areas is to look at using multiple techniques to best conserve and use the limited amount of water that Rajasthan has.

A Case Study

The RIFMP Phase II is implemented by Satya, An NGO in 35 villages around Jaipur in the districts of Dausa and Bhilwara. Satya's contract for this project is two years, from January 1, 2008 to January 1, 2010. Besides distributing, installing, and providing maintenance for the DDFUs, Satya is responsible for educating the communities about the proper usage of the devices and the importance of continued use once the program ends in 2010. Although the DDFUs will be left with villagers, the free support and recharge supplies will not, and it will be up to the individuals to continue to maintain the devices themselves. The education of villagers is done through village level meetings and awareness campaigns. Village facilitators, who are hired by Satya, conduct meetings to promote the use of DDFUs before they are installed. This is so that the villagers learn about the harmful effects of fluoride and get excited about using the DDFUs. If the villagers do not understand why the DDFUs are important, they will continue to drink unfiltered water and the fluoride problem will not be fixed. Unlike the BSWP where the water will be treated before it is distributed, this project relies on individual initiative to make the water safer. Therefore, education is just as an important part of the program as actually providing the DDFUs.

Satya's approach to education consists of several different programs. First, village awareness meetings are scheduled through the local Panchayat. Although this is a way for the facilitators to initially get people to come to the meetings and start building a relationship with them, only about one-tenth of the participants are women. This ratio between men and women is

consistent in most of the villages where meetings are held in association with the Panchayat. The problem with this is that women are generally the ones in charge of collecting and using water. Therefore, it is important for these programs to mainly attract women, who will ultimately play a bigger role in determining the success of the program. Although other awareness campaigns such as door-to-door solicitation cater more toward women, Satya needs to work on finding ways to get women to come to these group informational meetings because they are what will get the village community as a whole excited about the DDFUs.

Another awareness campaign is based on advertizing. Informational pamphlets and handbills are created to hand out to the community. Also, slogans and wall paintings are posted on local buildings about safe drinking water and fluoride. While these campaigns are effective in creating awareness and piquing curiosity, they alone will not convince people to use treated water. Personal interaction is more effective in convincing people of the importance of the DDFUs because more specific and personally relevant information can be given.

The results of the awareness campaigns have been encouraging in Satya's villages, and people seem excited about receiving the DDFUs. Although the DDFU regeneration centers have been set up, the actual kits will not be supplied and installed until after the May 2009 elections. Although the initial stages of the program seem to be successful, the true test will be whether or not the villagers continue to use the DDFUs to get safe water after the excitement wears off.

Government Inefficiency

Although contracting work out to local organizations is beneficial in many ways and ultimately makes the program more effective because of the ability of these organizations to work closely with the villages, the process of doing so is highly inefficient. The Communication and Capacity Development Unit (CCDU) of the State Water and Sanitation Mission, Rajasthan,

is currently in the process of hiring NGOs and other local organizations to implement the next phase of its rural water policy project. Although it is not directly a part of the RIFMP, the process of selecting NGOs and the goals of the program are the same. The government first posts a notice calling all interested parties to submit an application. In this case, a separate application is required for each of several districts the chosen villages are located in. After the closing date, the government invites all qualified parties to attend a "bid meeting." This meeting is virtually pointless and exemplifies the inefficiencies in the government in such programs.

The CCDU bid meeting was scheduled for 11:00am on April 11, 2009. At 11:50, most of the invitees along with the hosts of the meeting still had not arrived. Finally, around 12:05 the meeting was called to order. The first order of business was introductions. After finishing these introductions twenty minutes later, it was time for the chai break. Therefore, the meeting did not really "start" until 12:45pm, almost two hours after it was supposed to. The word "start" is used loosely because the actual meeting consisted of nothing more than the leaders opening each sealed application envelope, signing it, and reading out the name of the submitting organization. After they were done, each organization had to sign a document saying their applications had been received, and then the meeting was adjourned.[51]

Although there are some benefits to having everyone present to see the applications received, this method wasted many people's valuable time. Nothing was done that furthered the implementation of the project. Instead, the government just effectively postponed the reading and processing of the applications by waiting to open them until this scheduled meeting several weeks after the applications were due. In terms of programs that are only funded for two or three budget years, a few weeks worth of time can make a huge difference in how much an NGO or other organization can accomplish. Although it can be argued that projects get implemented in due time and that a few weeks do not really matter, this logic neglects to consider an important

point. If the funding for a project lasts two years, just 104 weeks, those 104 weeks start when the project is approved, not when it is actually implemented by the NGO. Three weeks, while not a huge amount of time, is a significant three percent of the total working period. In three weeks, an organization can do a considerable amount of education and relationship building, and those extra weeks could conceivably make a huge difference in whether or not villagers continue a program after the funding and assistance to do so stops.

NGO Inefficiency

If the government can be faulted for its inefficient use of time and lack of action, so can other involved parties. NGOs that work with the government on projects such as the RIFMP are required to submit quarterly reports of their progress. Satya's latest quarterly report shows that they are not working to their full potential on this project. As part of the RIFMP, the facilitators are required to have orientation meetings to learn how to use the DDFUs themselves as well as monthly meetings in each of the villages. On April 25, 2009, the facilitators came into Satya's main office for the first time in several months for this meeting. The "orientation meeting" that was held consisted of taking a group picture in front of a whiteboard with the name of the meeting written on it. There was no DDFU in sight, nor did they talk about how they work. This five minute fabricated meeting (with photographic evidence to submit to the PHED in their report) is just one example of things that are supposed to be done but are not. If the facilitators do not know how to use the DDFUs, they cannot implement them in the villages. The longer they are not implemented, the less time the communities will have to use them with free support. Out of a two year program, the villages under Satya's care will have working DDFUs for approximately only six months. If this is not enough time to make their usage routine, after the program ends, the villagers will most likely stop using them.[52]

As was stated before, in these time sensitive programs, each day is important. In Mandawari Khejrawali Dahni Village in Dausa District, a group of women are excited about the prospect of using the DDFUs to remove fluoride from their water. They are not exactly sure how they work, but have been told that using the DDFUs will make their children and families healthier. However, when asked whether or not they would pay for the units on their own if they were not provided for free, these BPL women were unsure. There are many other things that their families need as well. In just a few months, they are probably not going to see a noticeable difference in the health of their children, so paying to upkeep the DDFUs, even though it is relatively cheap to do so, will not seem as important or as high of a priority as it should be.[53]

Also, the DDFUs with Activated Alumina only work if they are maintained and recharged properly. In fact, if the filters are not recharged when the need to be, they can actually make the water quality worse. Although the filters are not difficult to recharge, they are not particularly user friendly for laypeople, and the government will stop paying someone to work at the regeneration centers at the beginning of 2010. If the villagers have not had the DDFUs for long enough to experience a variety of problems and servicing needs, they will not recognize when something needs to be fixed, nor will they be able to fix it. Although it would not solve this problem entirely, if the DDFUs were installed quicker, there would be more time to learn about them with an expert present. There would then be a better chance that villages would be self sufficient with regards to using the units once the RIFMP ends.

Policy Analysis

The RIFMP aims to fix a serious problem for the entire BPL village population in a reasonable amount of time. Although many villagers do not know what fluorosis is, it is a big problem, and one that is easily fixable by removing fluoride from drinking water. The PHED,

through the RIFMP, has found an affordable way to make drinking water safe from fluoride all over the state. This effort, and the fast rate of the project, should be applauded. Already, thousands of villages have been supplied with DDFUs and even more will as well in the next few years.

The side effects of the Activated Alumina do not outweigh the benefits of the fluoride removal. Although there may be a better way to remove fluoride in the future, the aluminum remnants should not be a reason for stopping the distribution of DDFUs. The other chemicals present in the water at unacceptable levels are problematic, but not as much so as fluoride. Eventually, the PHED needs to find a way to get 100% clean water to the villages, but this project is certainly a step in the right direction. Although not quite reaching India's water policy goals, the GOR has made substantial progress in just a few years. Additionally, this process is environmentally friendly and cost effective. Finally, the inefficiencies in implementation on both the government and NGO sides, although serious and preventable, can be found in any program implementation and do not signal a problem with the project itself.

The biggest flaw, therefore, is the short time frame of government expenditure for this project. Especially when considering the amount of time it takes to actually get the DDFUs installed, two years is not long enough to convince poor villagers of the importance of using these devices, nor is it enough time to expect them to become competent in using them. Further, the government has a responsibility to provide clean water to all. It is not practical economically to pipe treated water to every village. Because they are not, however, the PHED should continue to fund the upkeep of the DDFUs to families below the poverty line. The costs of regeneration are nominal when compared with the costs of other clean drinking water projects like the BWSP. Funding the program would also ensure the continued and proper uses of the DDFUs. Because the government is continually spending money on the urban water supply, it is only fair that they

continue to fund this project as well to come closer to the goal of treating people in urban and rural areas equally with regards to water supply.

Conclusion

Providing clean water to citizens is one of the GOR's hardest and most important jobs. Not only is it expensive, but there is a severe lack of available resources as well. For this reason, the projects that are being implemented to do so, the BWSP and the RIFMP, are not perfect. Both have important sustainability issues and neither completely reaches India's water policy goals.

It is easy to blame the party taking action whenever there are problems. It is even easier when that party happens to be the government. The bottom line is that it is easy to find fault with any program, big or small. Seldom is one able to find, let alone enact, a perfect solution. Money, time, resource, and feasibility constraints prevent us from choosing the "best" option in most cases. If this were not true, many of the world's problems would be solved today.

In the case of Jaipur, the Bisalpur Water Supply Project is not the perfect solution to the clean water problem because of its temporary time frame. Nor is the short DDFU program that does not truly clean the water the best policy for rural areas. However, both are good programs designed to help large numbers of people in the immediate future. Both work towards India's water policy goals, and although they do not completely reach them, they are a big step in the right direction.

There are problems in theory and implementation for both of these programs. The people quick to point this out, however, are unable to come up with better solutions, feasible ones at least. Who is at fault then? The government is inefficient, the media and academics are perhaps overly critical, and NGOs are not working to their full potential. But this is true of every sector in

every country. The problems with the Bisalpur Water Supply Project and the Rajasthan Integrated Fluoride Mitigation Project are completely legitimate and should be carefully considered. Better policies should be researched and the voices of all people should be considered when making decisions. However, it is important to consider all the positive things these programs are doing, and all the people that will soon gain access to clean water as a result of them. Overall, the government's efforts to provide clean drinking water to all through these two policies should be applauded. After all, problems do not solve themselves overnight.

Recommendations for Further Study

Because of the severity of the water problems in Jaipur, it is important to continue studying water policy. More work needs to be done in the areas of conservation and education in urban areas like Jaipur. Although NGOs are active in water conservation programs in rural areas, there are few programs in the cities. The effectiveness of conservation and education programs, whether implemented on a government or private level, needs to be studied. Also, more research should be done on the daily per capita drinking water requirements in both urban and rural areas to re-evaluate the pricing structure of water. Finally, the sustainability of Bisalpur water should be further studied in order to find a solution that would allow Jaipur to continue using the water after the year 2027.

Acknowledgements

I would like to thank a number of people for their help with this project. First, Dr. Azim Khan and Maria Stallone were instrumental in helping me formulate a research question and supporting me throughout the research process. I would also like to thank Mr. Goutam Merh for his help in translating my survey questions into Hindi, and along with Ms. Archana Merh and Ms. Bhavna Singh, teaching many wonderful Hindi classes. Finally, I would like to thank all the participants in this study for taking the time to talk to me about water issues in Jaipur.

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List of Acronyms

ADB: Asian Development Bank

APL: Above Poverty Line

BPL: Below Poverty Line

BWSP: Bisalpur Water Supply Project

CCDU: Communication and Capacity Development Unit

CECOEDECON: Center for Community Economics and Development Consultants Society

DDFU: Domestic Defluoridation Units

GOI: Government of India

GOR: Government of Rajasthan

Ha: Hectares

HEDCON: Health, Environment and Development Consortium

IBP: Increasing Block Pricing

JBIC: Japanese Bank for International Cooperation

JMP: Joint Monitoring Program for Water Supply and Sanitation

Km: Kilometers

MLD: Million Liters Daily

NGO: Non-government Organization

PHED: Public Health and Engineering Department

PPM: Parts Per Million

RIFMP: Rajasthan Integrated Fluoride Mitigation Program

RUIDP: Rajasthan Urban Infrastructure Development Project

SCAD: Supervisory Control Data Acquisition

TMC: Thousand Million Cubic Meters

WHO: World Health Organization

Appendix 1

Jaipur Drinking Water Survey

1. Where do you live?

2. Describe your current access to water. Does water come through a tap in your house? At what times? Do you have a tank and pump to store water?

3. Describe the quality of your water.

4. Do you purify your drinking water? How?

5. Do you ever get sick from drinking water? How often?

6. How does your water availability and quality compare with other areas in Jaipur?

7. What should the Government's responsibility be in supplying water? Is the Government fulfilling this responsibility?

8. What do you know about the Bisalpur-Jaipur Water Supply Project (BWSP)?

9. Have you been affected by the BWSP? If so, how has your water access/quality changed?

10. If not, do you expect the BWSP to come to you in the future? When?

11. Do you think that the BWSP is a good solution to the drinking water problems in Jaipur? Why or why not? If not, then what alternative do you suggest?

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