2008 SADHANA CLEAN WATER PROJECT

Developing Water

The Socio-Political Constraints to Clean Water Development in Rural India

A WHITMAN DIRECT ACTION PUBLICATION

DEVELOPING WATER: THE SOCIO-POLITICAL CONSTRAINTS TO PROVIDING CLEAN DRINKING WATER IN RURAL INDIA

WHITMAN DIRECT ACTION
SADHANA CLEAN WATER PROJECT 2008

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Abstract: *Providing access to safe drinking water is one of the preeminent issues faced by the developing world today. Globally, 1.1 billion people do not have access to safe drinking water, with 669 of those people residing in Asia (Asian Water Watch, 2006). Despite repeated efforts by private and governmental organizations to address this serious worldwide problem, populations in developing countries suffer from inadequate access to safe drinking water at rates virtually unchanged for three decades (Anthony, 2007). In order to understand some of the challenges of providing safe water access, this report examines the socio-political factors of water management in one particular region, focusing on the three villages of Kule, Nanegaon and Nandgaon, located in the Kolwan Valley in Maharashtra, India. Research methods included surveying respondents about water use, management and treatment activities, hosting small, demographic-specific focus groups to create dialog on water related issues, and conducting water quality tests to evaluate water being dispensed from communal sources. We found that descriptions of water management schemes by government officials, village water managers, and the villagers themselves often contradict one another, indicating an absence of established management procedures. In sum, we have determined that there is neither a uniform scheme for supplying safe water to the Kolwan Valley as a whole, nor is there consistent water quality among the villages. We tentatively identify links between these management schemes and a deteriorating public health, and we also offer provisional suggestions for a more cohesive management plan, including increasing public education and research.*

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INTRODUCTION

Whitman Direct Action and the Sadhana Clean Water Project

This report is a component of Whitman Direct Action's Sadhana Clean Water Project, an initiative to better understand and address the socio-political constraints to clean water access in rural India. Whitman Direct Action (WDA) is a non-profit, student-run organization from Whitman College in Walla Walla, Washington, United States, dedicated to helping marginalized people by promoting economically and environmentally sustainable community development.

The 2008 Sadhana Clean Water Project builds upon the successes of WDA's previous two projects in Latin America and seeks to be a small part in the movement to provide adequate access to safe drinking water to populations in developing countries. Despite considerable efforts by a multitude of private and public institutions to address this serious worldwide problem, populations in developing countries suffer from inadequate access to safe drinking water in numbers that have remained almost unchanged for three decades (Anthony, 2007). In an attempt to better understand the factors contributing to this lack of water improvement, this report closely examines efforts to deliver safe and reliable drinking water in one particular region, the Kolwan Valley in the western Indian state of Maharashtra. By analyzing this area in detail, this report aims to provide important documentation of the drinking water conditions, treatment programs, management schemes and actors involved in a largely typical rural agrarian setting. In doing so, the hope is ultimately to explore possible strategies with local non-profit organizations, community members and government bodies to improve the conditions of water access in India.

Our strategy is designed to promote a discussion about water access and development in the Kolwan Valley, and additionally to contribute to the resources available to those working towards the development of safe drinking water in rural India. We believe this to be a necessary first step in addressing the problems with water quality and access. To this end, we have authored the report here before you, which features an analytical discussion of our research in the Kolwan Valley. Our intention is that the report will become a resource for NGOs, the government sector, academics, and interested individuals to wish to participate in water development. Additionally, our hope is that this report will act as a foundation from which more research and productive change will begin to take shape. Additional information resources, as well as other components of the Sadhana Clean Water Project are available on our website at www.whitmandirectaction.org.

Why Water?

The Sadhana Clean Water Project was motivated by an understanding that access to safe drinking water is one of the preeminent issues facing the world today, particularly in

developing countries. In a 2006 report published by the Asian Development Bank (ADB), United Nations Development Program (UNDP), United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), and the World Health Organization (WHO), the authors strongly argue that achieving greater water and sanitation coverage across the world, and in Asia especially, is critical to improving all aspects of human welfare targeted in the UN Millennium Development Goals. The report, Asian Water Watch 2015, identifies clean drinking water as so integral to development because of its broad effect on all aspects of society. The quality of drinking water is a huge determinant of public health, and improvements in this area translate into greater productivity across society as a result of time savings and reduced expenses due to widespread improved health (37). Likewise, inadequate coverage of safe drinking water has far-reaching negative consequences for the health and general welfare of society.

Unfortunately, the scope of inadequate safe drinking water coverage worldwide is of a serious magnitude. Globally, 1.1 billion people do not have access to safe drinking water, with 669 million of these people residing in Asia (Asian Water Watch, 9). Historically, the problem has been especially bad in India, with the country reporting among the lowest coverage rates in the region in 1990 (15). However, the government has made an increased effort to ensure wider coverage, and as a result, India boasts among the greatest improvements in providing adequate drinking water in the Asian region over the past ten years. In a 2007 article titled "The Semantics of Success or Pragmatics of Progress?: An Assessment of India's Progress With Drinking Water Supply", P.B. Anand found that of India's overall population, 68% had access to a drinking water supply in 1990, and 86% had access in 2000 (33). In rural areas, where the problem tends to be worst, the Asian Water Watch 2015 report tracks access from 61% in 1990 to 82% in 2002. In fact, by the estimates of this report, India is "on track" to provide 100% coverage by the year 2015 (15).

Water in India

Numerous studies in the past have attempted to gauge access to adequate water supplies in rural India. Some of the most comprehensive information available on the situation in India comes from the National Sample Survey's 54th round, conducted in 1998. The standard established for acceptable conditions of supply, defined in India's 10th 5-year plan, is "40 lpcd [liter per capita per day] of safe drinking water within a walking distance of 1.6 km or elevation difference of 100 meters in hilly areas." According to the survey's findings, most households meet these standards. However, 60% of rural households depend on a principal water source outside the premises, with 9% of households having to depend on a source farther than 200 meters away (Anand, 2007, 42). Even though these circumstances meet the standards of acceptability, a considerable amount of time and labor costs that go unmeasured must also be involved when the primary water source is located at any significant distance from the household premises.

Principally speaking, water sources in rural India tend to be accessed through tube wells, hand pumps, traditional wells or taps. Use of these three modes of water collection is far more common than allocating water for drinking directly from tanks, rivers, and

springs. P.B. Anand's 2007 study finds that the proportion of rural households having access to tube wells or hand pumps in 1998 was 50.1%, while just ten years before, tube wells and traditional wells were the predominant source, claiming a proportional use of 39.1% in rural populations (43). Additionally, the interim saw a percentage increase of tap use in the home from 15.7% in 1988 to 18.7% in 1998. These increases resulted in a total of 68% of survey respondents claiming to use a tap, tube well, or hand pump while fewer than 5% used unprotected or unreliable sources such as ponds, rivers, springs or tankers (43). Anand also notes that the incidence of a shared primary water source is also quite common, with 77% of rural households accessing water communally (43).

Improving Water Sources

As Anand's study illustrates, the primary sources of water in India have been changing over the past twenty years. Still, the spectrum of water sources in rural India varies greatly in quality and kind, and to highlight the disparities among water collection mechanisms, the World Health Organization (WHO) has created a classification of common water sources, dividing them into what it determines to be sources of both an improved water supply and an unimproved water supply. The WHO considers "improved" supply sources to include water collected from a house connection, stand-post or pipe, borehole, protected spring or well, rainwater, or any water disinfected at its point of use. Conversely, an unprotected well, unprotected spring, vendor-provided water, bottled water, or water from tanker or truck are included on the WHO's "unimproved" list (Asian Water Watch 2015, 10).

Water and Public Health

Increasing the percentage of water sources that meet the WHO "improved" standards is of the utmost importance because methods of water delivery that provide access to cleaner drinking water can have an enormous impact on public health. In one 2003 study by Jyotsna Jalan and Martin Ravallion, titled "Does piped water reduce diarrhea for children in rural India?" the authors find that, overall, in households with piped drinking water, the prevalence and duration of diarrheal disease among children was significantly lower. The benefits of a piped water system appear to be further increased when the tap is located within the house, as opposed to a communal tap shared by several households (171). As Anand noted, a large majority of rural households access water communally, making these shared water sources important targets for improvement. This study is just one illustration of how improvements in the water system can directly improve the health of the population.

Findings by research studies such as the 2003 article by Jalan and Ravallion are important to consider, since reducing the prevalence of diarrhea among children in developing countries remains a pressing challenge. By Jalan and Ravallion's count, four million children die each year from diarrhea, mainly in developing countries (156). Indeed, diarrhea is believed to be the single biggest killer of young children in these regions (Asian Water Watch, 30). Thus, improvements in drinking water system can save billions of lives, as well as billions of dollars in associated healthcare costs. The report

claims that if South and Southwest Asia alone were to achieve the target of 100% coverage by improved drinking water sources and sanitation, 137 million cases of diarrhea would be averted each year, saving $2.5 billion annually (31).

Women and Education

Clearly, both the consequences of inadequate drinking water sources and the benefits of improved sources are staggering. However, studies suggest that the implementation of improved technology and water infrastructure alone do not bring about sufficient change. These developments must be accompanied by education and awareness programs in order to be effective, for, without education, people are less likely to understand the danger in drinking unclean water. In a 2003 study, author Rita Colwell finds a link between women's education and the likelihood that new water infrastructure will be effective. In her article titled "Reduction of cholera in Bangladeshi villages by simple filtration," she discusses that when women, especially the mothers of households, use and understand a filtration device, they often perceive a positive decline in the incidence of diarrhea within the family or household. Furthermore, an educated woman becomes the agent of information dissemination about the effective implementation of suggested filtration procedures due to her role in the household as head of water-related activities (1054). Needless to say, educating the population at large is important to maintaining intellectual integrity, but the education of women seems to be most important for ensuring safe access to clean drinking water.

In addition to the important benefits to public health of improved water systems, they can also play a significant role in promoting greater gender equity, one of the aims of the Millennium Development Goals. Particularly in rural areas, women in India still face considerable disadvantages when it comes to their position in society and corresponding access to resources. Saraswati Raju writes in "Locating Women in Social Development" that the role of women has remained largely confined to the home, as they are considered "second class earners" (84). Marginal access to education, training and skill formation follows, reflected in the fact that in 2001 only slightly more than half of women in India were literate, while the rate among men was 75% (84). Improvements in water systems can enable conditions that promote better equity in these areas.

Often due to unimproved water systems, women must spend a significant amount of time physically collecting water for their household needs each day. The authors of Asian Water Watch 2015 argue that the gains from spending less time collecting water, as well as the health benefits of improved water sources, help to provide the required time and health for women to attend school and participate in economic activities. In doing so, women "prove their worth by becoming cash-earning members of their households and communities" (2). As signified by the inclusion of gender equity in the Millennium Development Goals, achieving greater economic participation and access to resources for women is an initiative with positive outcomes for the entire spectrum of development goals aimed at increasing human welfare and economic prosperity. That drinking water sources can play an integral role in this process emphasizes again the importance of achieving improved access to safe drinking water worldwide.

Water Policy and Management in India

In order to maintain a certain level of water quality in all regions across India, there must be a water policy and regulation scheme put in place. According to P.B. Anand, a formal water policy did not exist in India until 1987; but, when the first National Water Policy was drawn up and put in place, it asserted that access to drinking water should be made a top priority followed by waters allotted for irrigation and hydropower respectively: "Adequate drinking water facilities should be provided to the entire population both urban and rural" (36). Although this goal and other strategies do exist for water management at the national level, there is room for variation within state and local management schemes.

Anand also outlines four possible state water regulation plans. In the first, more straightforward model the state government department provides the water supply with no help from the localities. Next, a plan might require a state government subsidiary to provide the water supply, and subsidiaries of this sort may include, for instance, a state water board. Third, a subsidiary or state government department may build a water supply system only to hand over all maintenance and operational duties to the urban or rural local government's responsibility. And last, a local government may be responsible for building, operating, and maintaining the water supply all on its own (36).

Although the state in India has been the primary planner of water regulation and development, Anand notes that non-governmental organizations (NGOs) are beginning to play a role in some areas in promoting small-scale conventional technologies such as rainwater harvesting (42). The authors of Asian Water Watch 2105 advocate for the increased recognition and support of these types of water management methods. By opening the management process to more actors, the report argues, there is a greater opportunity for citizen involvement. This is important, because to effectively target the poor with water development projects requires their direct involvement in the decision making process (4). The involvement of citizens may also have the effect of fostering wider social mobilization across the population, in turn serving to mobilize women and increase their empowerment (34).

About the Kolwan Valley

Although the research in this report should provide data and analysis relevant to many regions of rural India, we should make a point of noting the particular details of the locality of our study, since some of these regional conditions contribute to the specific conclusions of our research. We conducted our study primarily in the Kolwan Valley in the western Indian state of Maharashtra, with some supplemental research also occurring in the neighboring Mulshi Valley. Both valleys and their accompanying clusters of small rural villages lay within the Pune district of Maharashtra. A rapidly growing city, Pune benefits from its relative proximity and increasing integration with Mumbai, located about 160 kilometers to the northwest. The Kolwan and Mulshi valleys likely benefit from the resources of these nearby urban cities, but the primary management for these

rural agriculture areas appears to center around village councils and the regional block development officer (BDO) in the valley's largest village of Paud.

A type of village council known as a Grampanchayat generally oversees individual villages. Marathi, the indigenous language of Maharashtra is primarily spoken, although some Hindi is also used. Despite the small size of villages, most are divided by an arrangement that feature a Gaon, or central area to the village, surrounded by outlying collections of houses known as wadis. Sometimes the arrangement of wadis and the corresponding division of resources in villages is based on caste membership, even though such discrimination is officially outlawed in India. Although this basic village structure remains common throughout the region, the drinking water systems vary somewhat. In this study we have focused specifically on the three villages of Kule, Nandgaon, and Nanegaon and specific background information on each village is compiled in **Table 1.1.** These characteristics of the villages are important to keep in mind when interpreting data on the water situation in each location.

Table 1.1 *Information on the villages of Kule, Nandgaon, and Nanegaon.*

	Kule	**Nandgaon**	**Nanegaon**
Size	1500 hectares 1800 people 350 households	450 hectares 1,000 people 150 households	350 hectares 700 people 130 households
Wadis and distance from Gaon (village center)	Jangam Vasti, Marathiwadi, Sathe, Yadav, Varange, Harijan (all within 0.5 km)	Kharade (1 km), Ganga (2 km), Bernerkar (0.5 km), Baudha (0.5 km)	Lakhodi, Satputi, Shendri, Harijan Vasti (all within 0.5 km)
Primary Water Sources	Water from bore well near river pumped to open well near the village.	Well near river pumps to 20,000 L tank. Second 20,000 L tank from spring water.	Two bore wells near the village and one open well In the Gaon.
Sanitation	100 toilets (70 In gaon, rest evenly distributed among wadis).	90 toilets (none In Bernerkarwadi)	40 toilets (almost exclusively In the Gaon)
Water Shortages	None	Only receive water every four days from March through June.	N/A

There is a wide spectrum of types of water infrastructure within the Kolwan Valley. Some villages, such as Nanegaon and Bhalgudi, require significant manual labor to get water from dug wells or bore wells for a family. Others, such as Nandgaon and Hadshi, have community tanks that cut out the physical effort required for drawing water, but still demand hours for transportation. The two large towns in the valley, Paud and

Kolwan, both serve most of their populations with water access directly to the household. The most common source of water for the Kolwan Valley, however, is the bore well.

This Report

Again, providing access to clean drinking water is one of the most urgent problems facing the developing world today. Among its many consequences, India's current clean water deficiency compromises public health and plays a role in continuing gender inequity. To better understand the complexities of the water systems in rural India and to perhaps locate areas for improvement within the current management infrastructure, Whitman Direct Action has endeavored to research the socio-political constraints to supplying clean water access in the Kolwan Valley, an area located due south of the greater Mumbai area. Our hope is that by working with several villages, we will glean the expertise of local NGOs, government officials, and villagers who require the use of local water for daily activities.

The findings of this research report will hopefully also serve as a useful source of data for NGOs and other organizations currently working with water issues in the Kolwan region. More broadly, the case studies outlined here demonstrate the very complex and difficult environment NGOs face when endeavoring to improve the water delivery system in rural India, whether through the deployment of appropriate technology, health programs, or education campaigns. This research is the result of one small international NGO's attempt to engage with water issues in rural India, and we imagine that our experiences may be of interest to similar organizations.

METHODS

Surveys

In order to assess the socio-political factors shaping water access conditions in the Kolwan Valley, we decided it would be invaluable to examine the practices and perceptions of water use among the valley's villages. To accomplish this goal, we worked with our in-country partners to design a survey to be administered in the villages. The survey asked respondents questions related to water sources and availability, water collection and purification, water use, health and social issues, agricultural and sanitation practices, and finally opinions regarding who should be responsible for ensuring adequate water provision and treatment. This method of data collection was intended to provide us with an idea of how the sources of water in each village are affecting the lives of the villagers, as well as to potentially identify aspects of the villagers' lives, such as sanitation practices, that are affecting the condition of the water sources. A full list of questions included in the survey is provided in Appendix A of this report.

After Whitman Direct Action drafted a preliminary version of the survey in the fall of 2007, it was sent to students in a community development course at Mahindra United World College of India (MUWCI). With their feedback, we cut back on the number of questions and focused the scope of the survey. In January 2008, MUWCI students, with the help of translators, began implementing the fifth revision of our collaborative survey. At this point, another organization working in the valley, Gomukh Environmental Trust for Sustainable Development (or Gomukh for short) expressed interest in assisting with our research. Gomukh, based off their 10+ years of experience of working in the Kolwan Valley, added questions related to sanitation and a region-specific religious belief, the Sacred Groves. Also instrumental in the survey process were a group of sixteen high school students whom Gomukh trained to help administer the survey, and three volunteers from Mumbai who translated the information from the Marathi surveys back to English. In total, 142 surveys were completed for the study.

Although our partners surveyed twelve villages, we decided to focus our analysis on the three villages for which we had the most data: Kule, Nandgaon and Nanegaon. The survey was designed to work in conjunction with our other investigative methods of focus groups and water quality testing. We were only able to implement all three of these methods in these three villages, making them the necessary choice for this report's focus. We recognize that this may create some gaps in our analysis; however, focusing carefully on three villages in a relatively small area should still provide an acceptable sample size for investigating the general water issues facing the region. The tabulated responses to selected questions from the survey are included in Appendix B.

Focus Groups

Our survey results can provide one vital component to a schematic understanding of the valley, but we wanted to supplement them with qualitative research and gain an insight

into the role demographics play in the larger socio-political picture with regards to clean water access. What is each population group's responsibilities regarding water collection and purification; and, how does each perceive their role? How does each demographic feel about the water management schemes enacted by the local and regional government? Answering these and other, similar questions would allow for a more holistic study of the valley. To this end, we conducted focus groups or six-to-ten person forums, which were designed to foster dialog among villagers in an appropriate space for them to express what could be controversial opinions on these issues.

We began by targeting several, specific demographics based on our perceptions of their role within the water scheme. Our focus groups were arranged with the help and mediation of our endlessly helpful community hosts from Sadhana Village NGO and MUWCI, who maintain regular contact with the people living in the valley. Sadhana Village also aided us in determining how best to structure these focus groups and to consider particular cultural sensitivities, including caste, gender and age when inviting focus group participants. For instance, they helped us coordinate a ten person meeting with the youth leaders from Kule, Nanegaon, and Nandgaon that was held at Sadhana's community center. The NGO representatives saw value in creating conversation among villagers from several locales who hold a similar social status and who would have the initiative to create positive change as a result of information sharing. Other groups we arranged meetings with included women, school children from Kule, public and private health care officials who service the Kolwan Valley, government officials, and village water managers in each location the survey was issued.

The discussion topics in these focus groups reflected our survey questions but were tailored for each demographic. For example, the topics we posed to both the Kule school children and the group of community youth leaders included water collection, quality, availability and management, but we framed our discussion with the children through a lens of school programming and used more informal, accessible language when speaking with them. Similar to the surveying process, these conversations were translated for us by volunteers from Sadhana and Gomukh, MUWCI faculty members, and our accompanying Whitman College professor, Dr. Raechelle Mascarenhas. In sum, these conversations not only allowed for a better understanding of the valley's demographics, but also provided anecdotal evidence to support or refute the survey responses.

Village Water Sources Worksheet

While reviewing the preliminary results from the original survey implemented by MUWCI students and Gomukh, we realized we did not have enough information about the water collection, storage, and distribution systems in each village to accurately test for water quality. To better understand the impact of the water quality, we needed to know exactly who had access to which sources. In order to obtain this information, we created another questionnaire that was issued before any water quality tests were made. The questions for this survey were developed in the field and then refined after the first day of implementation. By seeking follow-up responses on the same themes addressed in

the previous survey, we hoped to additionally understand how responses might vary amongst the different demographics of the village.

This "Village Water Sources Worksheet" specifically targeted those who participate in village management. In general, we tried to speak with the Sarpanch (village head) or former Sarpanch, or a member of the Gram Panchayat (local governing council). Our questions inquired of basic information on the villages, including, village population, composition, and demographic distribution. Once we had the layout of the village established, asked about the primary and secondary sources of water for the village, who has regular access to each of those sources, and who is technically responsible for maintaining each source. Identifying each source allowed us to also ask about how often they are treated, cleaned, and tested—important information for understanding which aspects of the village's water system are functioning well and which are not. A complete list of questions asked in the "Village Sources Worksheet" is included in Appendix C.

Water Point Quality Worksheet

Once we had collected information on the specifics of each village's water supply, storage, and distribution schemes, we returned to test water quality from an assortment of sources which included open wells, bore wells, and community tanks. At each point, we tested for indicators of basic water quality to answer this primary question: Is the water in the Kolwan Valley generally safe to drink without further treatment?

To address this question we visited water sources throughout the Kolwan Valley and recorded extensive information on their conditions. The site's location was then marked down both in terms of the point's relation to local objects as well as the UTM coordinates by way of GPS. The type of water source was recorded from a list of options that would later allow us to speculate as to whether there is a correlation between the type of source and quality of its water. We also observed potential sources of pollution (agricultural, human, animal, or industrial) within sight to see if there were any glaring concerns.

After making note of the observable characteristics of each water source, the team tested the water empirically. Some assessments were possible in the field, while others required work in the science lab at MUWCI. At each source, we took recordings of the time, temperature, pH, and dissolved oxygen. For work later in the lab, we took water samples for turbidity, fecal coliform, and biochemical oxygen demand. Turbidity samples were collected in 1 L Fanta bottles, and then tested with Vernier equipment provided by the biology department. Fecal coliform levels were measured by collecting a water sample in a 25 mL bottle and incubating it in the lab to determine whether or not colonies were present. Additionally, biochemical oxygen demand was measured from two samples at each source collected in 100 mL reagent bottles. At the lab, one sample was placed in the sunlight while and one in the dark for a period of five days before being tested for dissolved oxygen. Compiling the results of these tests allowed us to make an analysis of each source's potability. The results of the tests are included in Appendix D.

A Note About the Difficulties of Our Research

The Sadhana Clean Water project has been a tremendous learning experience for all Whitman Direct Action members involved, and we acknowledge that its unexpected challenges may have created several shortfalls in our data collection and analysis. We feel it is important to illuminate the trials we experienced during the design and implementation of our project so that others endeavoring to continue or replicate some portion of our research may be better equipped to face similar hurdles.

The most salient difficulty we faced during the research process was the limited amount of time we were able to spend in the field, which was approximately two weeks. In order for a project of this scope to be carried out to its fullest capacity, we suggest that its duration be spread over several months or perhaps even years. Although extensive research of the valley took place before our arrival in India, two weeks on the ground neither allowed us the opportunity to become privy to the cultural sensitivities necessary for designing our surveys and focus groups, nor did it allow us the opportunity to learn communicative Hindi and Marathi before speaking with village water managers, government officials, and villagers. We were, however, fortunate to work closely with representatives from Sadhana Village, Gomukh Environmental Trust, and the Mahindra United World College, each of which is established in the valley and has nurtured good relations with the valley's residents. Their role as translators was crucial to the success the project.

Furthermore, after our first few days in the valley, we realized that acquainting ourselves with the valley before writing the survey and focus group questions would have allowed us to tailor our inquiries to directly reflect the conditions faced by the villagers in the Kolwan Valley. But after the surveys were issued and collected, we experienced yet another challenge due to language while attempting to interpret the completed surveys. They were issued to the villagers in Marathi and returned to us without translation back into English. As we did not have the capacity to translate them on our own, we owe another thank you to volunteers working with Gomukh who graciously offered their time converting the surveys back into English so that we could begin tabulating responses.

We also had difficulty obtaining data from government officials while we were in the valley. The information we requested included water quality information and health records for the entire Kolwan Valley. The regional government office was reluctant to disclose these reports perhaps because they did not want foreigners to see the data sets or perhaps due to the information's inaccessibility. Regardless, our inability to secure these records did create yet another pitfall during our research collection processes.

Our last noteworthy challenge occurred while conducting the water source surveys and the water quality tests. There where a few times when we traveled into the villages we could not readily find a water manager to speak with and were sometimes required to speak with multiple villagers instead. As such, our information may include some contradictions due to the differing perceptions between villagers and water

managers, but we feel this disparity is important to present because it illuminates the many attitudes within each village regarding water access, collection and purification. We make a point of noting the source of the contradictions in our analysis.

RESEARCH FINDINGS

To best assess the data from our surveys, interviews, focus groups and water quality testing, we have broken down our analysis into three thematic categories: Water Collection and Availability; Health, Disease and Awareness; and, Government, Management, and Information Dissemination. The focus on themes is intended to emphasize the connections between our statistical representation of the valley and our anecdotal evidence, to provide a more integrated picture of the water system in the Kolwan Valley.

Water Collection and Availability

Before analyzing the complex social and political dynamics of the water collection and distribution system in the Kolwan Valley, we first attempted to learn more about its basic function in Kule, Nanegaon and Nandgaon. Through visits to the villages, surveys and focus groups, we obtained information regarding what water sources villagers collect their water from, how they collect it, who collects it, and the extent to which water for drinking is treated or filtered. The findings of these investigations are presented in this section.

Sources of Water

To begin, it is important to recognize the several water sources utilized by the villages: these sources include water from mountain runoff, water from springs or water straight from the Kolwan River. Among the more common water delivery mechanisms are bore wells, which draw water from below the water table through pipes or tubes for village use. Hand-operated or motorized pumps typically power these wells. Villagers also use open wells, which require dipping buckets into uncovered water for collection. And last, tanks and pipes sometimes distribute water to communal taps (few households have private taps). We have found a variety of these water distribution systems in each of the three villages.

First, Kule's primary water source, the Kolwan River, is accessed through a bore well located near the river. Water is pumped daily from this well into an open well that services approximately 261 households in the main part of the village. However, in order to service Kule's remote wadis, water is diverted from the open well into two 50,000-liter tanks where villagers draw water from eight public taps. To be sure, in Kule as in other villages, water from these sources is used for a variety of individual and municipal purposes, but in our survey 73.3% of respondents reported that they used well water for human consumption.

Next, Nandgaon collects its water from two primary water sources: the Kolwan River and a mountain spring. Water from each source is stored in separate 20,000-liter tanks, both of which are located above the village. Gravity provides ample pressure to pump water from the river water tank into the village where it feeds eight communal

taps. However, there is no delivery mechanism into Nandgaon from the spring water tank; instead, those who choose to collect this water are required to use taps located at the tank. Additionally, Bernerkarwadi, a collection of eight houses approximately five kilometers away from the main gaon, has restricted access to the two tanks. Those residing in this wadi depend on an open well for their water needs.

Finally, Nanegaon's water scheme is different from Kule and Nandgaon, in that the Kolwan River is not the primary water source for this village. Instead, there are two bore wells with operational hand pumps servicing 7 and 15 households respectively, as well as one open well servicing 108 households. It is important to note that using separate wells from multiple sources results in a decentralized water distribution system: where the other two villages seem to be arranged around central, communal water access points, Nanegaon residents access water from several sources. However, even though Nanegaon does not distribute river water to the villagers for human consumption, our survey responses suggest the villagers may collect it on their own: nine of twelve respondents claim to use a nearby stream or the river for their drinking water. In the end, it is often difficult to say exactly where villagers collect water.

Although water may be available to a particular village through a well, tank, or pipe system, there is commonly an extra step required to deliver water from the village's central source to a resident's home. These methods can include private pumps (both human and machine powered), pipes, or the traditional method of carrying water in a bucket called a lothka. This is the most common method by far, as 77% of our survey respondents claim to collect water this way. Traditionally, lothkas were made of copper, which has a natural property of inhibiting bacteria growth (Versteegh). Now, however, most lothkas are made with stainless steel; consequently the latent antibacterial function of copper containers has been lost. Changing this method in transporting and storing water has had important implications for health, due to lost purification properties. Now, villagers are forced to rely on other methods for water treatment.

Treatment of Drinking Water

The villages in our study appear to lack a reliable water treatment infrastructure due to their limited resources. In the best-case scenario, we observed some water sources purified with chlorine or Total Chlorides of Lime (TCL), a bleaching powder with similar purification properties to chlorine. Additionally, villagers have implemented creative treatment solutions to include the sari filtration method. Sometimes villagers wrap saris around the nozzles of taps, a simple yet effective way of filtering out sediments from the water and an important first step in removing potentially harmful bacteria. On the other end of the spectrum, however, we observed that water drawn from both bore wells and open wells typically went unfiltered. This is of great concern especially for open wells, because "open" implies no protective covering over the water; this results in an increased potential for debris accumulation and also contamination.

The purification methods of each of the three villages in our study fall onto this spectrum, and it is important to note the differences among them. First, in Kule, the main open well is reportedly treated with one kilogram of TCL per day and tested for water quality weekly, but when this water is pumped to other distribution points in the village, it is not treated again. This creates the potential for contamination during transmission and storage in tanks which are cleaned approximately once per year. Additionally, in Jangam Vasti, the enclave of four houses on the outskirts of the village, the private bore well is only treated with 250 grams of TCL per month and is neither tested for water quality nor cleaned on a regular basis.

Nandgaon lays claim to arguably the most consistently treated and tested water. The village's two 20,000-liter tanks are both treated on a regular basis: the river water tank receives treatment every four days, while the spring water tank reportedly receives treatment every eight days. Additionally, Medichlor is issued to each household every three months. However, there is one exception to an otherwise reliable treatment system: the open well in Bernekarwadi is apparently neither treated nor tested at all.

Finally, Nanegaon is the least systematic at maintaining their water quality. Although the open well is treated with TCL once per week, regional government officials reportedly test the bore wells only once per month and furthermore only treat them with TCL if the water quality does not meet their standards. According to the Sarpanch, the Gram Panchayat provides the village with Medichlor only three times per year.

Locating the water sources and determining how they are being treated comprises only one piece of the water collection picture. Who is involved in the water collection process is also a critical dynamic that affects the impact of water delivery systems on the population.

Who Collects Water

Not only do water collectors retrieve large quantities from a communal source every day, but also they must also often cope with limited water availability due to a number of influences including seasonal rainfall fluctuation and government water allocation schemes. To assess the affects of the human resources spent on water collection, we will examine the dynamics of water retrieval, focusing on who is daily taking part in water collection, how long it takes to collect water, and the seasonal fluctuations that affect water availability.

First we will consider who is collecting water from the sources outlined above, for this information demonstrates where the labor burden falls within the community. After compiling and tabulating our surveys, we discovered that 94.3% of our total respondents reported that adult women collect water for their households, while only 2.9% responded with the assertion that adult men collect water. Similarly, 14.3% of our survey participants reported that female children help in daily collection activities, while 0% responded on behalf of male children. These figures suggest a gender divide, where

women play a role laden with far more responsibility than men, and that it is, in fact, a woman's job to supply each family with sufficient water for the day's activities.

To investigate this further, we compared these survey responses with anecdotal information from several focus groups in hopes that these conversations would support our tabulated findings. We spoke with a class of 60 school children – 30 girls and 30 boys – from Kule about their respective roles in water collection chores. When asked who collects water for their households, all of the girls raised their arms high to announce their involvement in the task. On the other side of the room where the boys were seated, only four arms were raised in the air. The children also commented that their mothers are involved in collection activities, but none spoke of their fathers' involvement. This provided a visual and verbal confirmation of what we had discovered from our survey analysis: women are more likely to be the primary water collectors for village households. Additionally, a conversation with the youth leaders from Kule, Nanegaon and Nandgaon during another focus group reaffirmed the assertions of the Kule school children and the claims made by our survey respondents in that it is, in fact, female members of the village who collect water. In sum, all components of our research supported the same general trend.

Not only is it important to discover where the labor burden lies within the villages, but it is also necessary to quantify the human resource spent on water collection because that time could be allocated to other life sustaining or income earning activities. From our survey data, 82.9% of our respondents claimed that water collection activities require an allocation of two hours or less; more specifically, 34.3% asserted that it takes less than one hour, and 48.6% claimed that it takes one to two hours. If a more convenient collection scheme were implemented and water retrieval times were shortened or eliminated, 45.7% of our survey participants claimed this additional time would be spent on agricultural enterprise, the prevailing livelihood for most of the villagers, and 37.1% reported it would be used for other work in general. Our remaining respondents reported that this time could be spent doing housework, for childcare or for recreation. One can see that water collection does, in fact, require a large portion of time and redirects human resource away from other important activities.

It is important to note that the time required for collecting water may change with the seasonal fluctuations in water availability. In light of this variability, we asked our survey respondents to report on the incidence of low, medium and adequate water availability for the summer, winter and monsoon seasons. 100% of our respondents report adequate water availability during the monsoon season, often called the rainy season, while for the winter and summer seasons, 51.4% and 25.7% of respondents reported adequate water access respectively. From our responses, one can see a general trend indicating a decrease in water availability after the monsoons subside. These figures indicate that our participant pool perceives roughly a 50% reduction in clean water access with the onset of each successive season after the monsoons.

Conclusion

In our study of Kule, Nandgaon, Nanegaon, and the Kolwan Valley at large, we observed a water management system that lacked consistency and uniformity in practice due to the number of different management schemes at the village level. Additionally, we have observed that the schedule for testing and treating water is varied, largely dependent upon the prevalence of disease outbreaks and how proactive the Gram Panchayat is instead of an overall schematic plan.

Regardless of whether a village provides water through wells, pumps, or tanks, our survey results and interviews generally indicate that there is a considerable amount of labor involved in accessing water. Very few people have taps in their houses, which means that most households must physically carry water in buckets from a communal source to the home. On average, the members of the household responsible for obtaining water must each spend between one and two hours per day transporting water to the home. Almost exclusively, women play the role of water collector.

In addition to the nuisance of having to physically carry water to the home, the amount of time spent on this task may have broader consequences. Many of our survey respondents reported that they would use the time spent collecting water for livelihood supporting activities such as agriculture. It is likely that if a more efficient system of delivering water to households existed, overall productivity could increase somewhat, as people would be able to spend more time working. This means that limited systems for delivering water are not just a feature of rural poverty, but may in some way be a contributing factor of these conditions.

The fact that women are left with the burden of collecting water also raises some issues of gender disparity. Men are generally in control of the local and regional governments responsible for providing water access, yet it is the women who must deal with the physical work determined by the type and extent of the water system the government implements. Additionally, if women spend a significant portion of their day collecting water, it further confines their place in society to the home. This makes it more difficult for women to participate in the income-generating activities that could provide them more ownership of the household.

Health, Disease and Awareness

Water Quality

The water quality of a public source plays a huge role in the health of those who depend on it for drinking and cooking. Simply examining methods of water collection, delivery and treatment indicates neither the actual quality of the water people are drinking, nor the potential health impact of the water quality. In order to add a quantifiable measurement to our assessment of the water system in the Kolwan region, we collected water samples from different sources of drinking water in Kule, Nandgaon and Nanegaon and tested them for a variety of basic water quality indicators. This section, however, will cover

those indicators that are most relevant for immediate human health concerns, to include the presence of fecal coliform and nitrate levels.

According to World Health Organization (WHO) standards, any presence of fecal coliform bacteria in drinking water is a health threat ("Guidelines for Drinking Water Quality"). The most prevalent type of fecal coliform bacteria is Escherichia coli, more commonly known as E. coli, a leading cause of diarrhea ("Basic Information About E. coli in Drinking Water"). The presence of these bacteria in drinking water usually indicates contamination by human or animal fecal matter. Additionally, the WHO's Guidelines for Drinking Water Quality, 3rd Edition, claims that the "greatest microbial risks are associated with ingestion of water that is contaminated with human or animal (including bird) [feces]. [Feces] can be a source of pathogenic bacteria, viruses, protozoa and helminths."

To address microbial contamination, it is reportedly standard practice for the regional government to provide Total Chlorides of Lime (TCL), a bleaching powder compound. From our data, we believe that this purification tool is used poorly or in some instances not at all. For example, in Kule, the team tested the open well accessible to the village proper, an open well intended for Sathewadi, and the private bore well at Jangam Vasti. Of the water samples from these three sources, all tested positive for fecal coliform, while the second open well exhibited the most significant bacterial growth. The samples for Nandgaon included water from the spring water tank in the village proper as well as from the open well near Bernekarwadi. Both sources tested positive for fecal coliform, and once again the open well had the highest degree of bacterial growth. Nanegaon provided the only sample from all three villages that did not test positive for fecal coliform. Across the entire valley, 10 of the 15 sources we tested were positive for fecal coliform.

Another potential health concern are nitrates, which occur naturally in the environment. However, they can be introduced at higher levels from fertilizers and pesticides, which typically percolate into ground waters through run-off from fields and seepage into groundwater. According to WHO standards, the level of Nitrates in drinking water should not exceed 12 milligrams per liter (mg/L). Too much Nitrates in drinking water can cause methemoglobinemia, known as "blue-baby syndrome," in infants, often leading to death if left untreated ("Drinking Water Contaminants"). In the samples we collected, Nitrate levels from every tested source in all three villages exceeded WHO standards, with values ranging from 15 mg/L to 40 mg/L.

Table 1.2 *Results from water quality tests.*

	WHO Standards	**Kule (3 Samples)**	**Nanegaon (1 Sample)**	**Nandgaon (2 Samples)**
Presence of Fecal Coliform Bacteria	None	Yes, all 3 samples	No	Yes, both samples

Nitrate	12 mg/L or less	High = 40 mg/L, Low = 20 mg/L	30 mg/L	High = 20 mg/L, Low = 15 mg/L

The government health office also monitors water quality periodically, and we had the opportunity to see results of the most recent tests during an interview with the District Health Organizer (DHO) in Paud. In November 2007, 142 water samples were tested and 13 showed signs of contamination. The contaminated samples came from the villages of Balgudi, Hadshi, and Nanegaon. Tests were conducted again in December of that year, and this time water samples from Balghudi, Hadshi, Kashi, and Nanegaon were all contaminated. The DHO did not say what bacteria or chemicals constituted contamination.

As one might imagine, there are innumerable other ways the water supply can become contaminated: open wells and leaks in pipes and tanks allow contaminants from the surrounding environment to enter the water source. A private doctor from a nursing home in Paud also described that contamination can occur when people rinse their utensils in the water they will drink, or when they touch a pot that is dipped into the source with dirty hands after defecating. The daily activities in which villagers partake present a multitude of obstacles to overcome for the end goal of ensuring clean drinking water.

Disease Prevalence

The scarcity of water treatment devices in Kule, Nandgaon and Nanegaon, coupled with the results from our water quality tests showing fecal coliform and nitrate levels in excess of WHO standards, suggest that there might be health concerns arising from the quality of drinking water. In an attempt to gauge the impact of drinking water quality on the population, we interviewed two local doctors and included questions on our survey about the prevalence of water-borne and water-related illnesses.

The first doctor we interviewed was a private physician servicing the Kolwan Valley. In his assessment, almost 50% of the patients he treats have some type of a water-borne disease. The most common of the illnesses he encounters are amoebas and parasites that can cause diarrhea and other problems including giardia, tapeworms, and, during the monsoon season, typhoid and hepatitis A. From our survey results, we found that diarrhea was by far the most commonly reported illness among respondents. 37% reporting that they had suffered from the severe diarrhea symptom associated with dysentery. This illness was not reported as much of a problem in Nanegoan as in the other two villages, with 8.3% of the respondents there reporting diarrhea, compared with 33.3% in Kule and 87.5% in Nandgaon. A complete breakdown of responses is included in Appendix B.

We heard a slightly more positive assessment of the situation when we spoke with the DHO in Paud, a government employee who oversees programming in four valleys. He provided valuable insights, beginning with a description of Maharashtra State's public

health care system and the assertion that it lays claim to a unique health care concept. It is a decentralized management system, which means that the DHO works on public health programming at the local level while his branch is governed by a central oversight committee located in Paud. He asserted that malaria is now the biggest water-related health concern in the area, and that of the four valleys he oversees, the Kolwan is one of two under a governmental health watch due to problems with diarrhea in the past. In his opinion, however, water-borne diseases like diarrhea and malaria are becoming less of a concern as government programs are now geared toward educating people about the importance of clean drinking water for their health.

It is not especially surprising, however, that private and public health practitioners would have slightly differing assessments of the situation. According to one private health care doctor, when public health officials identify problems with water-borne illnesses, they are expected to address the problem but have limited funds to do so. Nevertheless, based on our survey results, the government health watch, and one physician's experience, it appears that unsafe drinking water does, in fact, have some negative effect on the health of the local population. Fortunately, there are a few programs in effect to combat the problem, and at least the DHO thinks they have some impact.

Education and Awareness

In light of the observed and reported incidences of water-related disease and illness in the valley, we inquired the doctors further in order to better understand the educational programs detailing precautionary measures for handling unsafe water. The private doctor first introduced us to a new phrase, which helps to articulate the importance of educational programs on water quality and by which to gauge health awareness with respect to contaminated waters. The term is water literacy. Applying it to an individual implies that he or she understands the link between unclean water and any water-related disease resulting from contact with or consumption of unsafe water. In other words, any water literate individual will understand the causal factors associated with water-related illness. The doctor told us he believes it is not medicine that will make villagers more water literate, but rather education. He hopes that increasing levels of water literacy through regular implementation of the various educational programs will reduce the incidences of water-related disease.

We then inquired of the DHO further, and discovered he believes the number of illnesses to have fortunately decreased - except during the monsoon season - due to the implementation of educational programming. Two programs that reportedly have had an effect on water literacy in the valley are the Integrated District Program and the Sanitary Survey. The first is a government program initiated to provide awareness of water-related disease in the villages by offering water purification training sessions and conducting water quality tests within the localities. The quality tests are administered by the Grampanchayat to test for appropriate chlorination dictated by the use of TCL, and Medichlor, another chlorine compound. The DHO did not offer detailed information about the training sessions, but suggested that they have been beneficial to attendees.

The second program, called the Sanitary Survey, is an educational water-monitoring program issued just before the monsoon season in the months of April and May. Surveyors are sent to participating villages in order to evaluate water quality. If the water quality is on par with government standards, the village is offered a green card and is considered prepared to move forward into the monsoon season without changing its purification schemes. Conversely, if water quality is sub-standard, the village is offered a red card in which case the village must take measures to mitigate contamination before the monsoon season. After the surveys are conducted, the DHO explained that health education programs are hosted to demonstrate the link between unsafe water and illness. Again, this program is yet another example of how to teach water literacy.

Not only was this conversation helpful in garnering an understanding of the educational infrastructure in the valley, but so too were our discussions with focus group participants. When we visited the school at Kule, the headmaster explained to us that there is no year-long, civil education course designed to teach students about the importance of clean water; rather, there are informal discussions in the children's science classes about water quality issues. The predominant challenge faced by the school, if they were to consider adding water quality courses to their curriculum, is the level of knowledge held by the teachers. The school owns several microscopes that are adequate for a scientific analysis of water, but the teachers do not have sufficient training to guide their students in using these tools properly. Both the headmaster and the children explained a government-initiated program, however, which provides the students with medichlor, fondly dubbed the "mother's solution" by the children. The program teaches the students how to use the solution for purification purposes, and encourages them to share this knowledge at home with their families. This short seminar-like program is hosted just before the monsoon season at which time the importance of evaluating water quality is at its highest. Water is easily contaminated by sedimentation and contaminated runoff during the rainy season and precautions must be taken to prevent health consequences.

As some participants in our focus group with the youth coordinators were from Kule, we took the opportunity to verify the information provided earlier by the headmaster and students in the Kule school system. We first inquired the youth coordinators as to whether or not their children are involved in water purification activities at home. The youth leaders responded that the children do, in fact, bring the government issued medichlor home to teach their families about proper purification practices they learn in school. Additionally, the leaders claimed that they would be in favor of including the children in conversations about water quality. It appears that the government has been successful in targeting a wide range of villagers through their initiatives in the school system. Here one can see the importance of anecdotal information and the value in structuring focus groups such that the information in each will overlap to either verify or refute information from other conversations; we now have a clearer picture of Kule’s health education programs.

Finally, as government appears to play a role in establishing a level of water quality awareness in the villages, we scheduled a meeting with the Block Development

Officer (BDO), whose job it is to oversee water allocation and management schemes at all levels of local government. According to the BDO, over the past four to five years the local government has hired trained officials to distribute medichlor during the monsoon season and also to give instruction on how to use the chemical. He mentioned that there are approximately 25 villagers who attend each training session. Again, to reference our focus group with community youth leaders, we were delighted that these men were in favor of allowing their wives and women of the village to participate in these training sessions. As women hold most responsibility for water collection and purification at the household level, their having knowledge of water quality issues would be most important for increasing water quality and water literacy rates within the villages. One shortfall of this program, however, is that it does not include curriculum about water-born disease; programs structured such that there is no reference to potential diseases will ultimately not increase the number of those who are water literate.

Conclusion

From our investigation into water quality, disease and awareness, one can see that the three issues are linked through their correlation: poor water quality leads to health concerns and these, in turn, lead to the necessity for educational programs.

First, it appears that water quality is not consistent throughout Kule, Nandgaon and Nanegaon. But in general, the water is poor enough to require purification in order to mitigate detrimental health consequences. For instance, one can see with our tests for fecal coliform and Nitrates that in all three villages water quality is below WHO standards. But with the myriad sources of contamination, it is difficult to pin point one as the primary contaminant; rather, all three villages appear to suffer from the effects of poor sanitation practices in general.

While there are reported illnesses in the valley, overall it is difficult to say which disease the villagers most often fall victim to, due to the villagers' overarching inability to discriminate between water-born illness and illness not associated with water contamination. For example, the instances of self-reporting are high in Nandgaon while extremely low in Nanegaon, and it is hard to tell whether this disparity is a result of better purification practices and water of generally higher quality in Nanegaon, or perhaps a result of water illiteracy among respondents In Nanegaon. In short, our survey results alone are not a conclusive measurement of the prevalence of water-born illness in the villages, since the likelihood of respondents attributing common illnesses such as diarrhea to unsafe water varies with the level of water literacy.

Currently, however, there is an optimistic outlook on disease prevention and identification within the valley. Both the public and private health care doctors agree that educating villagers about the importance of clean water has not only already begun to decrease water-related illness in the valley, but also led to increased levels of water literacy. The most common educational program is water purification training sessions that have been implemented valley-wide. It appears that the government has selected its target groups wisely for these sessions, as it is most important for the women and

children to receive the training. Targeting children will create a greater awareness of water quality for the next generation; and, training women will most likely be the best way to achieve higher levels of sanitation at the household level for they typically oversee all household activities associated with water use.

Governance and Management

The last prong of our investigation leads us to a discussion of government and management practices to evaluate water and treat for sub-par quality. How often are quality tests administered? And how often are they administered? What kinds of management practices are in place? Conversations with the Block Development Officer (BDO) and members of the regional government office helped us to gain an understanding of the valley's management system. This research also provides some important examples of the challenges involved in maintaining a safe drinking water system in rural India, and highlights some successes achieved by local actors.

In order to begin answering these questions, we first met with the BDO, whose job it is to oversee both the water management schemes at all three levels of local government and the allocation of water to the 17 villages in the valley. The BDO also supervises the purchase of water from the Tata Mulshi Dam Project, a private water source, and then its distribution to the separate localities in the neighboring Mulshi Valley.

When asked to explain the Kolwan's water management schemes, the BDO described to us that up until five years ago, the government did provide a schematic infrastructure for water management within the villages, which came in the form of a monetary contribution. The government used to pay 50% of the maintenance fees for source and point water collection devices and 50% of all electricity bills associated with water collection. But for reasons the BDO did not share with us, the year 2003 marked the end of those contributions. Currently, however, the government does aid in water access and allocation: the villagers need only make a 10% tax contribution to the government in order to secure water access, leaving the regional government with the responsibility of paying the remaining 90% for water access. As one might imagine, if the villagers fail to pay the full 10% in water taxes, problems arise between the villagers and their governing body which can, in turn, lead to water shortages. The BDO shared last year's figures with us, however, the reported shortcomings did not appear to be significant enough to cause shortages in the water supply as the expected tax revenue was Rs. 20 Lakhs, 12,000 and the actual tax collection of Rs. 24 Lakhs, 43,000.

Although the government no longer makes a contribution for maintenance and electricity bills, its resources are shared with the villages in the form of water quality testing. The BDO assured us that two engineers evaluate the condition of the Kolwan Valley's water on the first Tuesday of every new month. The public health care doctor, another government employee, also informed us that the government funds daily testing by a multi-purpose health worker who manages chlorine levels. In sum, the government does claim to support multiple programs for water quality testing.

Villagers and the Government

From our interviews with the BDO and DHO, we learned that at least officially, water testing in villages is supposed to occur on a regular basis, generally the first Tuesday of every month. However, when we spoke with a group of male youth leaders during one of our focus groups, none were aware of regular water quality testing. It is possible that because women who do most of the water collection, and spend the most time at the water source, the men might simply be unaware of the testing. Even if this were the case, it indicates that the government is not communicating its programs effectively with citizens of the villages.

Given that the men we spoke with held prominent positions in the villages and that they demonstrated knowledge of the water system during our conversation, it seems likely that at least some of these individuals would be aware of a regular water testing scheme. Also, when we interviewed the water manager or village head of each village where we tested water, we found in general that only one or two water sources in each village received regular treatment. This not only suggests that the government is not always able to follow through on its program, but also highlights a disconnection between the different levels of the government and the village citizens. The regional BDO may oversee the general structure of the water management program, but it is often up to the Grampanchayat or the village water manager to implement it. Therefore, there are many levels at which miscommunication can occur, which degrades the water management system's chance for effectiveness.

Indeed, during our focus group with the youth leaders, several mentioned that a key component to a system providing reliable, safe drinking water is nurturing good relationship between the villagers and the Grampanchayat. In a few villages, the Grampanchayat was responsive to requests regarding the water system, and the youth leaders felt this resulted in significant improvement in comparison with other villages where the Grampanchayat had been largely unresponsive. Despite the fact that the BDO and the state government has withdrawn somewhat from providing support for the water system, which is evidenced by the cessation of paying 50% of the maintenance and electricity bills, the concerns of the youth leaders show that many villagers still look to their relationship with the local government as the source of good water resource management.

The results from our surveys further emphasized the importance of the government, the Grampanchayat in particular, in providing adequate water to the villages. When asked who the survey respondents thought should be responsible for ensuring there is enough water to meet village needs, 82.9% from all three villages reported that it should be the Grampanchayat. This does not mean, however, that the government is the only party that can play an active role in the water system. According to the private health care doctor’s experience, health conditions are somewhat better in Kolwan’s neighboring valley called the Mulshi largely because the private company TATA owns a dam there, and as part of its contract it must implement water literacy and monitoring

programs in the area.

Additionally, our survey results showed a markedly different response when it came to the matter of ensuring that village water is safe for drinking. Respondents from Nandgaon held the same expectation of the Grampanchayat, but in Kule, 33.3% reported that the villagers themselves should be responsible for this task, and in Nanegoan 100% gave this answer. In these villages at least, it appears that people prefer to have ownership over the water purification process or simply feel as though the project does not merit the use of government resources.

Conclusion

Perhaps the most troubling trend we encountered during our research of the water management system in the Kolwan Valley was the widely varying and sometimes contradicting stories we heard from different demographics within the valley. Regional government officials reported extensive and regular water testing programs, but local water managers and the villagers themselves were often unaware of these programs or indicated that they were often not fully carried out at the local level. Furthermore, the data from our water quality testing suggests that the government may not be treating water sources to the success they report. Some Grampanchayats have been responsive to the demands of their constituents, where in other cases villagers felt their voices were not heard, and that the quality of the their water sources suffered accordingly.

Despite these frustrations and confusions, our surveys indicated that people still look to the government as possessing the primary responsibility for providing water. Responses in Kule and Nanegaon also suggested that in the realm of water safety and treatment, villagers themselves are willing to take on the responsibility. This may open the space for non-state actors to play a larger role in water management in these localities, as Gomukh has indeed begun to do in Nanegoan. With so many different actors in the water system, and the seemingly inconsistent approach to water management that appears endemic, it becomes increasingly important for all of these different groups to work together. Everyone has the same basic goal of providing adequate, safe water to meet village needs, but we did not see cohesive cooperation among the invested parties to work together while addressing the issue.

DISCUSSION

The drinking water situation in the Kolwan Valley appears to be incredibly complex and widely varying, especially for such a relatively small area. Thus our study can only claim to scratch the surface of the issue. Nevertheless, throughout our basic investigation a number of trends consistently emerged. The very complexity of the situation, with its many local variations, is an indication of how the water management system seems to be decentralized and somewhat disconnected, without clear leadership or oversight. When water sources fall through the holes in the system and go untreated, obvious concerns for public health arise. Indeed, in speaking with health workers in the valley we learned of prevalent health issues arising from water-borne illnesses such as diarrhea. We feel that this trend alone is enough to make safe water access a priority for study and action on the part of the government, NGOs, academic institutions, and citizens. Also there are numerous additional dynamics to the situation that only further the case for taking a closer look at the issue.

The preeminent problem we observed is the systematic discrepancy in the water management procedures described by regional government officials, the village Grampanchayats, the village water managers, and the villagers themselves. Often, one management program would be described to us by several demographics, and each would explain a particular program's implementation with different information. For instance, government officials may assert that water quality testing does, in fact, occur on the first Tuesday of every month, but the villagers may suggest otherwise. Our water quality assessments would seem to provide more preliminary credibility to the accounts of the villagers. We can speculate that disconnects like these may partly be a symptom of the variation in water regulation programs from state to state, given that India does not require a standard management program. However, what is particularly striking is that these disconnects occur at a very local level, with significant variations just between neighboring villages in the Kolwan Valley, and keep in mind this is but one small region in the single state of Maharashtra. We also saw that there were several different actors involved in water management, both in terms of levels of government and the involvement of non-governmental entities, and these parties did not seem to share a cohesive or cooperative management plan.

Of course, a huge factor in the scale and organization of any water management plan is the amount of resources allocated for the project. We recognize that it is unrealistic in many cases to criticize the scope of the water management plan, given the resource constraints the government must face. Rather, what is troubling is that we repeatedly observed that different actors' plans already funded and implemented did not seem to be in close communication with each other. It appears to us that the effectiveness of water treatment and management plans could be greatly enhanced if practices are made standardized and official and if regular modes of communication are established between the various stakeholders.

During our research, however, we did witness what we hope may be the

beginnings of this type of collaboration. In helping us translate our discussions with government officials, representatives from our partner NGOs became a part of the dialogue, in some cases speaking to officials about the issue for the first time. The government response appeared largely positive, and because of the recent Freedom of Information Act, the officials felt obliged to provide access to important records about water quality in the villages. We strongly urge groups working to provide safe drinking water in rural areas across India to take advantage of this law and to develop a stronger dialogue with the government about the issue. It is also extremely important for different NGOs operating in the same region to collaborate on addressing the issue of supplying clean water. In this regard, the conditions we saw on the ground in the Kolwan Valley support the recommendations of previous studies for involving more actors in water management and increasing transparency (Asian Water Watch 2015, 4).

However, in other ways our research findings may actually complicate the conclusions of previous studies. The international development institutions that authored Asian Water Watch 2015 claim that India is on track to providing 100% coverage of improved drinking water sources by the year 2015 (15). If the conditions we encountered in the Kolwan Valley are any indication of the situation in rural India, then the goal of 100% coverage by 2015 is far from complete. We do not mean to discourage, but rather to remind that providing safe drinking water remains a pressing priority. While in the last ten years India's government has been successful in making the greatest water access improvements in Asia, there still remain 669 million Asia at large without access to clean water (15). In the Kolwan Valley, and in places with similar conditions, it is our opinion that a pronounced shift from the status quote will be required if those 226 million are to have reliable access to safe drinking water. Some cooperative problem solving will also be required.

There is much at stake in addressing the problems with safe water access. Better water management policies would not only become a catalyst for achieving more wide-spread coverage of clean drinking water, but would also boost both human welfare and productivity at the same time. This would thereby result in positive change for current public health conditions and cut government costs associated with health care as well. Additionally, increasing the number of improved water sources would save women time and allow them to engage in activities that promote their empowerment, resulting in increased gender equity.

Perhaps the most important thing that can be done is increasing education about water management at all levels of society. Both of the doctors we spoke with felt that programs to increase awareness about the correlation between water quality and health, what one termed as “water literacy,” are absolutely vital in reducing the incidence of water borne diseases in the Kolwan Valley. The doctors were mainly referring to the villagers’ education, and their understanding of both the necessity and the means to treat drinking water to make it safer. This is indeed critical, but it is also important to increase education for officials in charge of managing water systems, as recommended in Asian Water Watch 2015 (30).

The good news is that according to the District Health Coordinator (DHC), awareness campaigns have already had a significant impact in reducing the incidence of diarrhea and other water-related illnesses in the Kolwan Valley. We also learned of education programs targeting schoolchildren and heard from youth leaders that the children are bringing the lessons home to the household. Such programs should be encouraged and increased.

On that note, we hope that this report can in a small way contribute to increasing education about water management in the Kolwan Valley. If perhaps we have presented no new information to those already working in the area, then we hope that we have at least shown that the issue is worth studying further. In order to address the situation effectively it is important to first study the water system comprehensively and with vigor. Access to reliable, safe drinking water is a basic human right, and every effort must be made to extend this right to all individuals. The potential benefits to society, and on a larger scale, to humanity, are enormous.

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APPENDIX A: SURVEY QUESTIONS

Surveyor:
Date:

RESPONDENT DETAILS
Name:
Age:
Gender:
Occupation:
Position in household:

Name of Village:
Distance to Pune:
Approximate location in Kolwan Valley:

WATER SOURCES/AVAILABILITY
1) What is the source of water for each of the following uses? (please only indicate for uses your household is responsible for)

Human consumption (if multiple answers are submitted, please indicate I, II, etc.)

___ River
___ Stream
___ Ground water (from a well)
___ Bottled
___ Rain collectors
___ Reservoir
___ Other (please clarify source):

Animal consumption (if multiple answers are submitted, please indicate I, II, etc.)

___ River
___ Stream
___ Ground water (from a well)
___ Bottled
___ Rain collectors
___ Reservoir
___ Diversion canal
___ Other (please clarify source):

Agricultural use (if multiple answers are submitted, please indicate I, II, etc.)

___ River (via diversion canal)
___ Ground water (from a well)
___ Seasonal reservoir (filled with rain water)

___ Other (please clarify source):

Other use (please clarify type):
___ River (via diversion canal)
___ Ground water (from a well)
___ Seasonal reservoir (filled with rain water)
___ Other (please clarify source):

2) Seasonally, how available (quantity) are the sources of water for each type of use?

Human consumption
January - March: High Medium Low
April - June: High Medium Low
July - September: High Medium Low
October - December: High Medium Low

Animal consumption
January - March: High Medium Low
April - June: High Medium Low
July - September: High Medium Low
October - December: High Medium Low

Agricultural use
January - March: High Medium Low
April - June: High Medium Low
July - September: High Medium Low
October - December: High Medium Low

Other use (if specified above)
January - March: High Medium Low
April - June: High Medium Low
July - September: High Medium Low
October - December: High Medium Low

3) Regarding water for human use, how is the water delivered from its source to your family? (multiple answers are permitted)

___ Pump (Human-powered)
___ Pump (Motorized)
___ Bucket
___ Pipes
___ Other (please clarify):

WATER COLLECTION/PURIFICATION

1) Who collects water for your household?

2) How is this task assigned?

3) How much time does this person spend collecting and/or purifying the household's water supply?

4) Where is the water stored in your household? Furthermore, how is it stored?

5) Does your household use purified water for drinking and cooking? (yes/no)
If so, using what technique? (multiple answers are permitted)
___ Boiling the water
___ Purification tablets (i.e. iodine or similar)
___ Sediment filtration at river
___ Filters (at the household or in the village) (please clarify type):
___ Other (please clarify):
If using Appropriate Tech, please clarify on who funds the system.

6) How many hours does the person primarily in charge getting of water for household use spend each day with that task?

WATER USE
1) How much water does your household use per day for their own personal needs? (include buckets per day and the approximate size of bucket)

SOCIAL TOPICS PERTAINING TO WATER
1) Has anyone in your household has any of the following diseases in the past five years? (if multiple answers are submitted, please indicate number of times per household)
___ Cholera
___ Diarrhea
___ Dysentery
___ Worms (of any sort)
___ Other (please clarify):

2) When a household member is ill (anything beyond a common cold), will you or household seek the help of a medical professional? (yes/no)

3) How does your household dispose of human waste? Food/other waste?

4) In the past 10 years, have these organizations helped your household or village in the following areas?
Non-Governmental Organizations (multiple answers are permitted)
___ Water access
___ Water quantity
___ Water quality
___ Other (please clarify):

If yes, please briefly describe each project:

Private volunteers (multiple answers are permitted)
___ Water access
___ Water quantity
___ Water quality
___ Other (please clarify):
If yes, please briefly describe each project:

Grampanchayat (multiple answers are permitted)
___ Water access
___ Water quantity
___ Water quality
___ Other (please clarify):
If yes, please briefly describe each project:

Other organization(s) (multiple answers are permitted) (please clarify):
___ Water access
___ Water quantity
___ Water quality
___ Other (please clarify):
If yes, please briefly describe each project:

5) Are there water sources available to others which are not available to you (or the opposite)?
If so, please explain type, quantity, and background:

IN YOUR OPINION
1) Who needs to be responsible for making sure there is enough water for all of your village's needs?

2) Who needs to be responsible for making sure this water is safe to drink and use?

3) If your household or village doesn't already make sure its water is clean (through purification and/or testing), why not?

4) If someone in your household became sick from the water, who's fault would that be?

5) In what aspects of your daily life is water commonly wasted/ misused/ overused?

6) In what aspects of your daily life is there not enough water?

7) Is waste in your village properly disposed of?

8) What would you do to improve access to water, water quality, water quantity, and

lesson disease?

SURVEYOR NOTES

1) Please note questions where confusion arose, and what the confusion was over

APPENDIX B: SURVEY RESPONSES

Number of total respondents (N): 35

Villages: (N)
Kule: 15
Nandgaon: 8
Nanegaon: 12

Male respondents:
Kule: 15 (100%)
Nandgaon: 7 (87.5%)
Nanegaon: 10 (83.3%)
TOTAL: 32 (91.4%)

Female respondents:
Kule: 0 (0%)
Nandgaon: 1 (12.5%)
Nanegaon: 2 (16.7%)

Mean respondent age:
Kule: 37 years
Nandgaon: 45 years
Nanegaon: 47 years
Overall mean: 43 years

1) Sources of water for human consumption:

Village	Pipe from Stream	Well	Dam	Stream/River	Tank	Rainwater	Sacred Grove	Tanker
Kule	2 *(13.3%)*	11 *(73.3%)*	2 *(13.3%)*	6 *(40.0%)*	1 *(6.7%)*	3 *(20.0%)*	6 *(40.0%)*	0 *(0%)*
Nandgaon	7 *(87.5%)*	1 *(12.5%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
Nanegaon	10 *(83.3%)*	8 *(66.7%)*	3 *(25%)*	9 *(75%)*	0 *(0%)*	0 *(0%)*	1 *(8.3%)*	5 *(41.7%)*
TOTAL	**19 *(54.3%)***	**20 *(57.1%)***	**5 *(14.3%)***	**15 *(42.9%)***	**1 *(2.9%)***	**3 *(8.6%)***	**7 *(20%)***	**5 *(14.3%)***

2) Sources of water for animal consumption:

Village	Pipe from Stream	Well	Dam	Stream/River	Tank	Rainwater	Sacred Grove	Tanker
Kule	0 *(0%)*	3 *(20%)*	3 *(20%)*	12 *(80%)*	0 *(0%)*	5 *(33.3%)*	2 *(13.3%)*	0 *(0%)*
Nandgaon	2 *(25.0%)*	3 *(37.5%)*	0 *(0%)*	2 *(25.0%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
Nanegaon	4 *(33.3%)*	2 *(16.7%)*	7 *(58.3%)*	10 *(83.3%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*	0 *(0%)*
TOTAL	**6 *(17.1%)***	**8 *(22.9%)***	**10 *(28.6%)***	**24 *(68.6%)***	**0 *(0%)***	**5 *(14.3%)***	**2 *(5.7%)***	**0 *(0%)***

3) Source of water for agriculture:

Village	Pipe from Stream	Well	Dam	Stream/River	Tank	Rainwater	Sacred Grove	Tanker
Kule	0 *(0%)*	1 (6.7%)	2 *(13.3%)*	13 *(86.7%)*	0 *(0%)*	2 *(13.3%)*	1 *(6.7%)*	0 *(0%)*
Nandgaon	0 *(0%)*	2 *(25%)*	0 *(0%)*	5 *(62.5%)*	0 *(0%)*	1 *(12.5%)*	0 *(0%)*	0 *(0%)*
Nanegaon	3 *(25%)*	8 *(66.7%)*	10 *(83.3%)*	10 *(83.3%)*	0 *(0%)*	10 *(83.3%)*	7 *(58.3%)*	3 *(25%)*
TOTAL	**3 *(8.6%)***	**11 *(31.4%)***	**12 *(34.3%)***	**28 *(80%)***	**0 *(0%)***	**13 *(37.1%)***	**8 *(22.9%)***	**3 *(8.6%)***

4) Seasonally, how available is water?

	Summer			Monsoon			Winter		
Village	**Low**	**Medium**	**Adequate**	**Low**	**Medium**	**Adequate**	**Low**	**Medium**	**Adequate**
Kule	6 *(40%)*	5 *(33.3%)*	4 *(26.7%)*	0 *(0%)*	0 *(0%)*	15 *(100%)*	0 *(0%)*	8 *(53.3%)*	7 *(46.7%)*
Nandgaon	6 *(75%)*	0 *(0%)*	2 *(25%)*	0 *(0%)*	0 *(0%)*	8 *(100%)*	0 *(0%)*	8 *(100%)*	0 *(0%)*
Nanegaon	0 *(0%)*	9 *(75%)*	3 *(25%)*	0 *(0%)*	0 *(0%)*	12 *(100%)*	0 *(0%)*	1 *(8.3%)*	11 *(91.7%)*
TOTAL	**12 *(34.3%)***	**14 *(40%)***	**9 *(25.7%)***	**0 *(0%)***	**0 *(0%)***	**35 *(100%)***	**0 *(0%)***	**17 *(48.6%)***	**18 *(51.4%)***

5) Water delivery system:

Village	Pump (human powered)	Pump (machine powered)	Buckets	Pipes
Kule	0 (0%)	2 (13.3%)	10 (66.7%)	3 (20%)
Nandgaon	0 (0%)	0 (0%)	8 (100%)	1 (12.5%)
Nanegaon	1 (8.3%)	0 (0%)	9 (75%)	2 (16.7%)
TOTAL	**1 (2.9%)**	**2 (5.7%)**	**27 (77.1%)**	**6 (17.1%)**

6) Who collects water?

Village	Adult Female	Adult Male	Female Child	Male Child
Kule	14 (93.3%)	0 (0%)	1 (6.7%)	0 (0%)
Nandgaon	8 (100%)	0 (0%)	2 (25%)	0 (0%)
Nanegaon	11 (91.7%)	1 (2.9%)	2 (16.7%)	0 (0%)
TOTAL	**33 (94.3%)**	**1 (2.9%)**	**5 (14.3%)**	**0 (0%)**

7) Amount of time that person spends collecting water:

Village	Less than 1 hour	1 to 2 hours	2 to 3 hours	More than 3 hours
Kule	8 (53.3%)	5 (33.3%)	2 (13.3%)	0 (0%)
Nandgaon	1 (12.5%)	5 (62.5%)	2 (25%)	0 (0%)
Nanegaon	3 (25%)	7 (58.3%)	1 (8.3%)	0 (0%)
TOTAL	**12 (34.3%)**	**17 (48.6%)**	**5 (14.3%)**	**0 (0%)**

8) If this time was saved, how would you use this time?

Village	Other Work	Agriculture	Recreation	Childcare	Housework
Kule	11 (73.3%)	2 (13.3%)	2 (13.3%)	0 (0%)	0 (0%)
Nandgaon	2 (25%)	5 (62.5%)	0 (0%)	0 (0%)	1 (12.5%)
Nanegaon	0 (0%)	9 (0%)	0 (0%)	3 (25%)	0 (0%)
TOTAL	**13 (37.1%)**	**16 (45.7%)**	**2 (5.7%)**	**3 (8.6%**	**1 (2.9%)**

9) Does your household use purified water for drinking and cooking? (Y/N) If so, what technique?

Village	No	Yes, TCL	Yes, Boiling	Yes, Filter
Kule	0 (0%)	10 (66.7%)	3 (20%)	4 (26.7%)
Nandgaon	1 (12.5%)	5 (62.5%)	2 (25%)	0 (0%)
Nanegaon	0 (0%)	10 (83.3%)	2 (16.7%)	1 (8.3%)
TOTAL	**1 (2.9%)**	**25 (71.4%)**	**7 (20%)**	**5 (14.3%)**

10) What personal needs does the household use the water for?

Village	Bathing	Drinking	Washing	Animals	Cooking	All Purposes
Kule	10 (66.7%)	5 (33.3%)	2 (13.3%)	1 (6.7%)	0 (0%)	1 (6.7%)
Nandgaon	7 (87.5%)	6 (75%)	0 (0%)	0 (0%)	3 (37.5%)	0 (0%)
Nanegaon	8 (66.7%)	2 (16.7%)	11 (91.7%)	1 (8.3%)	3 (25%)	0 (0%)
TOTAL	**25 (71.4%)**	**13 (37.1%)**	**13 (37.1%)**	**2 (5.7%)**	**6 (17.1%)**	**1 (2.9%)**

11) Would you drink rainwater collected from your rooftop? (Y/N) If no, why not?

Village	Yes	No	No, it's dirty	No, we have enough
Kule	4 (26.7%)	0 (0%)	11 (73.3%)	0 (0%)
Nandgaon	2 (25%)	0 (0%)	5 (62.5%)	1 (12.5%)
Nanegaon	2 (16.7%)	3 (25%)	2 (16.7%)	5 (41.7%)
TOTAL	**10 (28.6%)**	**3 (8.6%)**	**18 (52.4%)**	**6 (17.1%)**

12) Self-reported water-related diseases:

Village	Cholera	Diarrhea	Dysentery	Worms	Malaria	Other
Kule	3 (20%)	0 (0%)	5 (33.3%)	0 (0%)	1 (6.7%)	1 (6.7%)
Nandgaon	0 (0%)	0 (%)	7 (87.5%)	0 (0%)	0 (0%)	0 (0%)
Nanegaon	0 (0%)	1 (8.3%)	0 (0%)	0 (0%)	0 (0%)	1 (8.3%)
TOTAL	**3 (8.6%)**	**1 (2.9%)**	**12 (34.3%)**	**0 (0%)**	**1 (2.9%)**	**2 (5.7%)**

13) When a household member is ill (anything beyond a common cold), will you or your household seek the help of a medical professional? (Y/N)

Village	Yes	No
Kule	14 (93.3%)	0 (0%)
Nandgaon	7 (87.5%)	0 (0%)
Nanegaon	12 (100%)	0 (0%)
TOTAL	**33 (94.3%)**	**0 (0%)**

14) Who should be responsible for ensuring there is enough water to meet village needs?

Village	Grampanchayat	Surpanch	Villagers	Everyone
Kule	11 (73.3%)	4 (26.7%)	0 (0%)	0 (0%)
Nandgaon	7 (87.5%)	0 (0%)	1 (12.5%)	0 (0%)
Nanegaon	11 (91.7%)	0 (0%)	1 (8.3%)	0 (0%)
TOTAL	**29 (82.9%)**	**4 (11.4%)**	**2 (5.7%)**	**0 (0%)**

15) Who should be responsible for ensuring that village water is safe to drink?

Village	Grampanchayat	Surpanch	Villagers	Everyone
Kule	8 (53.3%)	2 (13.3%)	5 (33.3%)	0 (0%)
Nandgaon	6 (75%)	2 (25%)	0 (0%)	0 (0%)
Nanegaon	0 (0%)	0 (0%)	12 (100%)	0 (0%)
TOTAL	**14 (40%)**	**4 (11.4%)**	**17 (48.6%)**	**0 (0%)**

16) Aspects of villagers' daily life for which there is not enough water:

Village	Drinking water	Agriculture	Livestock	Washing
Kule	7 (58.3%)	2 (13.3%)	1 (6.7%)	1 (6.7%)
Nandgaon	7 (87.5%)	1 (12.5%)	0 (0%)	6 (75%)
Nanegaon	11 (91.7%)	0 (0%)	0 (0%)	0 (0%)
TOTAL	**25 (71.4%)**	**3 (8.6%)**	**1 (2.9%)**	**7 (20%)**

17) Do you normally use a toilet?

Village	Yes	No
Kule	4 (26.7%)	11 (73.3%)
Nandgaon	1 (12.5%)	7 (87.5%)
Nanegaon	5 (41.6%)	7 (58.3%)
TOTAL	**10 (28.6%)**	**25 (28.6%)**

18) Do you use a full bathroom?

Village	Yes	No
Kule	7 (46.7%)	8 (53.3%)
Nandgaon	4 (50%)	4 (50%)
Nanegaon	9 (75%)	3 (25%)
TOTAL	**20 (57.1%)**	**15 (42.8%)**

APPENDIX C: VILLAGE WATER SOURCES WORKSHEET

Village name:
Date:
Surveyor name:
Location (UTM):
Person(s) interviewed (Name and title):

VILLAGE INFORMATION

Number of people in village:

Number of hectares composing village

What are the names of the different wadis? (SC, village proper, etc.) How many houses in each wadi?

What is the primary water source for the village? Secondary?

How many taps in each wadi? Hand pumps? Other means of getting water?

Are there toilets in the village? How many? In which wadis?

When, if ever, does water consumption reduce? By how much?

What are the potential sources of pollution in the village? (sugarcane crops near water sources, pesticides used, etc.)

Does the villagers receive Medi-Chlor? If so, how often?

Is there a waste collection scheme for the village? (Y/N) If yes, how does it work?

For water managers: how many hours do you work, and how many times do you pump water, per day?

WATER INFORMATION

Source point #	1, ID:	2, ID:	3, ID:	4, ID:	More?
Type (Tap, well, tank, etc.)					
Where is it located?					
Who has access to this point?					
How many people regularly use this source?					
Where are the leaks in this system?					
Does this point ever go dry?					
Does this point get treated regularly? (Y/N)					
- If Y, how? (TCL, etc.)					
When was the last time this point was cleaned? How often is it cleaned					
How often do you test this source? When was the last time?					

Note: "Source point" refers to a point at which water is either held or distributed; tanks, ponds, pumps, and taps are all good examples. "ID:" is the short code for the village, reference the village spec sheet, and the source number in three digits.