Final Deliverable

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Deliverable Outline

Introduction

Innovo Consulting will help Sustainable Innovations quantify the benefits and effects of its rainwater harvesting program called Aakash Ganga. Sustainable Innovations is currently in its second phase of funding for the Aakash Ganga program. The government of India and the state governments of Rajasthan and Gujarat saw the positive results from the implementation of the rainwater harvesting program in the first six villages. The governments agreed to fund the implementation of Aakash Ganga in 1,000 villages if Sustainable Innovation can show the success of the program by implementing it in 100 villages and create a feasibility assessment and plan for implementing the model in 1,000 villages. Thus, Innovo Consulting's work of quantifying the benefits of the program will help Sustainable Innovations gather funding to pursue the implementation of Aakash Ganga in 100 villages, as well as provide information for Sustainable Innovations to use when applying for grants, awards, programs, and other donations.

Most Important Information

While conducting research, Innovo Consulting found statistics that it found would be especially helpful to Sustainable Innovations while trying to quantify the benefits of Aakash Ganga and describing the potable water scarcity problem in Rajasthan. The data listed below is explained further under the section head title in the Deliverable.

I. Impact of Potable Water Access:

   A. For 76% of households in India, women are responsible for gathering water for their families. Because women are spending a majority of their days collecting water, India is losing 150 million workdays per year which translate to a 10 billion rupee loss ($160 million in U.S. dollars).[1]

II. Water Resource Management in India:

   A. Due to a dramatic decrease in rainfall of 20-60% rainfall in 16 of Rajasthan's 33 districts, many people in Rajasthan have resorted to private suppliers[2]. The majority of these suppliers only provide water every eight

[1]http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf

[2]http://www.business-standard.com/article/economy-policy/rajasthan-s-deepening-water-crisis-116050300933_1.html

days. The suppliers charge RS 300 or $4.32 USD at an exchange rate of 68.62 RS for 1 USD for 3,000-4,000 litres per week.[3]

B. Throughout Rajasthan, 19 out of the 33 districts are affected by famine, and nearly 17,000 out of the 44,672 (38%) villages are facing a water crisis. In parts of rural Rajasthan, only 39% households have drinking water facilities within their premises.[4] Each day, around 32% families travel half-a-kilometre to fetch drinking water.[5]

C. According to Water Aid[1], 140,000 children die each year from diarrhea due to contaminated water, while 383 people die from diarrhea due to contaminated water each day. 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year.[6]

D. Reports from 2014 and 2015 indicate that the government is only using 37% of its designated water management budget.[7]

E. From the launch of the Five Years Plan in 1951 to 2016, approximately $16,572,944,700 US Dollars have been spent on providing safe drinking water.[8]

F. Only 791 per 1,000 households in rural Rajasthan have access to improved sources of drinking water while just 747 households receive sufficient drinking water throughout the year.[9]

III. Educational Impact of Having Safe Water Available:

A. Women in rural areas can walk over 14,000 km per year obtaining safe drinking water.[10]

B. As part of a fiscal plan written in 2012, India plans on spending Rs. 62.4 billion (~ $1 billion USD) by 2017 to help clean the water in 10,000 canals, lakes and rivers.[11]

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[3]Ibid.

[4]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[5] Ibid.

[6] http://www.wateraid.org/~/media/Publications/drinking-water-quality-rural-india.pdf

[7]http://www.livemint.com/Opinion/VpODtln8lv3dEF9C8bYdUP/Government-spending-Numbers-dont-lie.html

[8] http://www.wateraid.org/~/media/Publications/drinking-water-quality-rural-india.pdf

[9]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[10] http://ncw.nic.in/pdfreports/Women%20&%20Water.pdf

[11]http://www.bloomberg.com/news/articles/2014-08-14/india-plans-to-spend-1-billion-to-clean-waters-by-2017

IV. Direct Economic Impact of Health Benefits:

A. According to government minister Birendra Singh, contaminated water is a prevalent problem in Rajasthan, due partly to over-fertilization, affecting 22,254 habitations as of 2015 that lacked access to safe drinking water.[12]

B. According to the *World Health Organization*, implementing water quality intervention systems reduces the number of cases of diarrhea by 50%.[13]

V. Educational Impact of Having Safe Water Available:

A. When areas have access to clean sanitation facilities and clean water, girls are no longer responsible for helping their mothers collect water, which gives them time to receive an education. For girls, enrollment rates have improved by 15% or more when this occurs.[14]

VI. Direct Economic Impact of Health Benefits:

A. In 2006, according to the *Indian Journal of Occupational and Environmental Medicine*, poor sanitation conditions amounted to 54 billion USD, which was about 6.4% of the country's GDP. Of this figure, over 70% of the costs were related to health, with 12% due to diarrhea and respiratory infections.[15]

B. According to their study, in communities with decent sanitary conditions, improving the quality of drinking water could lower the concentration of fecal coliforms "by two orders of magnitude," resulting to a decrease in cases of diarrhea of 40%.[16]

C. In addition, the spread of many water-borne diseases, like diarrhea can be mitigated through increased access to clean drinking water. According to the *World Health Organization*, implementing water quality intervention systems reduces the number of cases of diarrhea by 50%.[17]

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[12]http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms
[13]Ibid.
[14]http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf
[15] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/
[16]http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms
[17]http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms

D. In India, between 0.4 and 0.5 million children under the age of 5 years die due to a diarrheal illness, which results from hygiene issues.[18]

VII. Direct Economic Impact from Environmental Benefits:

A. According to Save the Water, a village in the state of Haryana with 7,000 residents paid Rs 700-800 for a tanker of water and Rs 30,000 for water every day during a drought in 2014.[19]

B. Under the utility model of water supply, utility-operated tanker-trucks deliver 20L of water per capita per day[20].

C. Reducing traffic from tanker trucks would reduce PM10 particulates (large dust particles). Cutting these particles by 30% would result in a 0.04% cut in the annual GDP, but "would save a total of $47bn-$105bn from reduced damage to human health and cut CO2 emissions by 30-60 per cent."[21]

D. According to Rajasthan's Public Health Minister Kiran Maheshwari, groundwater levels have been declining by 33 cm per year over the past decade.[22]

Calculated Cost Benefits of Aakash Ganga

In order to help Sustainable Innovations quantify the benefits of the system, Innovo Consulting used data that it found to help express the impact of the implementation of Aakash Ganga. Since there is not exact data that is easily found and calculated about water scarcity and potable water access, these calculations have calculated using the best data available. In order to determine how these numbers were calculated, refer to the "cost calculations" excel spreadsheet and the appendix at the end of this document.

1. Reduction in Households Dependent on Women for Water if Aakash Ganga Implemented in all of Rajasthan: 65,556,526. This would translate in 3914 working days saved and a RS 3817.83 or USD 3817.83 savings in the economy.[23]

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[18] Kumar, Ganesh S., Sitanshu Sekhar Kar, and Animesh Jain. "Health and environmental sanitation in India: Issues for prioritizing control strategies." *Indian Journal of Occupational and Environmental Medicine*. 2011 Sep-Dec; 15(3): 93–96. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/

[19] http://savethewater.org/2014/10/22/haryanas-budaak-village-lacks-drinking-water-decides-to-boycott-elections/

[20] http://onlinelibrary.wiley.com/doi/10.1029/2009WR008693/full

[21] https://www.ft.com/content/0a89f3a8-eeca-11e2-98dd-00144feabdc0

[22] http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-has-least-availability-of-water-and-least-reliable-supply-Report/articleshow/18550029.cms

[23] Appendix: Calculation 1

2. The cost of providing water to a village using tankers per year is $963,346.10. The implementation of the Aakash Ganga system costs $150,000 and lasts for approximately 25 years. The savings, over 25 years, of implementing an Aakash Ganga rainwater harvesting system is $38,645,029.19.[24]
3. The number of households provided sufficient access to water in one village is approximately 271 by the implementation of one Aakash Ganga system.[25] This calculation could be improved by using the average consumption of water per day (135 liters) and the capacity of water that the Aakash Ganga could hold/provide. Additionally, using the average rainfall in Rajasthan of 570 mm, frequency of rain in months, the average usage of the Aakash Ganga system, and the capacity of the system, more accurate benefits could be determined.

Impact of Potable Water Access

To prepare our research, Innovo Consulting assessed the Aakash Ganga program to determine the benefits it brings to the villages.

I. How does the Aakash Ganga rainwater harvesting system affect communities?
   A. The Aakash Ganga system implements rooftop rainwater harvesting systems in towns that do not have easy access to potable water. Therefore, this program provides potable drinking water using technology and integrating itself culturally into the community. Sustainable Innovations educates homeowners and villagers about the cleanliness of the water from the system, the technology used, and the benefits of the program.

II. What costs does it reduce?
   A. Aakash Ganga provides potable drinking water to villages, which reduces the costs that the Rajasthan government spends providing safe drinking water to rural villages. Thus, less money has to be spent on tankers and the administration of limited water supplies due to Aakash Ganga's durability and self-sustaining characteristics. Additionally, the rain water harvesting improves many other factors of life in villages, that result in reducing various costs. Aakash Ganga reduces the time spent fetching water, increases school attendance, improves villagers' health, and gives more freedom to those who were traditionally obtaining water.

III. Does it make a difference in daily lives?
   A. Sustainable Innovations' program creates major change in the lives of villagers, especially women and children who would be otherwise forced to travel distances to obtain water. More women are able to get jobs or focus

[24] Appendix: Calculation 2
[25] Appendix: Calculation 3

on education. Girls and boys are able to spend more time on education with the implementation of this system

IV. What is the difference between communities with good water access and without good water access?
    A. There are a multitude of benefits that accompany easy potable water access. The most important benefits are health dangers that are removed when potable water is improved. In addition to health benefits, there are a variety of benefits that stem from increased free time due to the decrease in time required to acquire water. This increased free time allows children to be educated and adults to relax. Additionally, this free time can strengthen families and allow parents to rest from their daily lives.
    B. An example in Ajmer, Rajasthan is women who travel three kilometers to the only well which has safe drinking water three times a day. They manage to bring back two pots of water in each trip - about 5-7 liters - which is not enough for a family of five[26].

V. Does the economy thrive more?
    A. Overall, access to potable water means a healthier society, which translates to more efficient workers. Access to potable water translates to greater health, more free time, and better school attendance; which affect the economy directly. Healthier people will take less sick days, which will benefit local economies as well as the public and private workforce since workers will be more productive.
    B. For 76% of households in India, women are responsible for gathering water for their families. Because women are spending a majority of their days collecting water, India is losing 150 million workdays per year which translate to a 10 billion rupee loss ($160 million in U.S. dollars)[27]. This is time that women could spend working and having a positive economic impact. Implementing Aakash Ganga means that women can search for employment and gain empowerment through economic freedom.

Water Resource Management in India

Innovo Consulting has discovered that there is a dire need of water access and sanitation in Rajasthan, India. Water is contaminated through sewage, agricultural runoff, and over consumption of groundwater, which has caused increased expenditures by the government to provide potable drinking water to the rural population. Innovo Consulting created the following questions in order to assess water resource management in India.

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[26]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[27]http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf

I. What is India's water scarcity problem like?
   A. According to a World Water Development Report, India ranks a poor 120 in a list of 122 countries ranked for their water quality as also their ability and commitments to improving its quality.[28]
   B. Currently, India has more people without access to clean water than any other country in the world. According to WaterAid, approximately 76 million people lack access to safe water[29]. Due to a dramatic decrease in rainfall of 20-60% rainfall in 16 of Rajasthan's 33 districts, many people in Rajasthan have resorted to private suppliers[30]. The majority of these suppliers only provide water every eight days. The suppliers charge RS 300 or $4.32 USD at an exchange rate of 68.62 RS for 1 USD for 3,000-4,000 litres per week[31].
   C. This is very costly since the minimum wage in Rajasthan is 201 RS or lower in some areas. This is one example of the ways in which India faces challenges in ensuring a reliable, sustainable and safe drinking water supply to rural households of the country in particular.

II. How is the Rajasthan region affected by it?
   A. According to the DHI Group, a water and environmental protection company, "Rajasthan is India's largest state, covering an area of 342,000 km² with a population of 56.5 million people. The Aravalli mountain range runs from the south-west of Rajasthan to the north-east. This has divided the state into two distinct geographical regions – the Thar Desert covering over 60% of the state's land (which leaves Rajasthan acutely deficient in water supply) and the fertile eastern region. The distribution of Rajasthan's urban centers is related to climatic conditions, water resources, and soil fertility. As such, the north-west region is sparsely populated compared to the eastern region. Historically, Rajasthan has some of the best planned cities and towns in India. However, rapid urban population growth over the last four decades has resulted in considerable degradation of these urban areas."[32]

   B. Throughout Rajasthan, 19 out of the 33 districts are affected by famine, and nearly 17,000 out of the 44,672 villages are facing a water crisis. In parts of rural Rajasthan, only 39% households have drinking water

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[28] http://www.hgsitebuilder.com/files/writeable/uploads/hostgator427959/file/ijars351.pdf

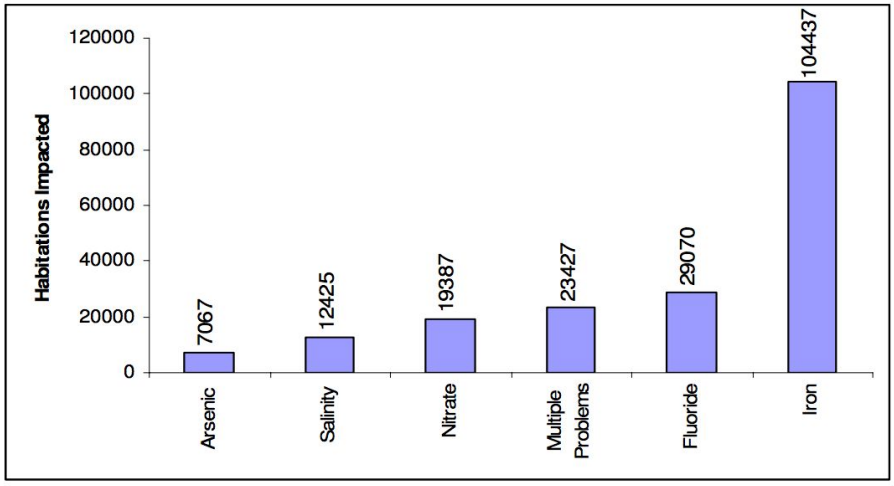
[29]http://www.dhigroup.com/upload/publications/scribd/205941526-Rajasthan-Water-Distribution-DHI-Solution-IN.pdf

[30]http://www.business-standard.com/article/economy-policy/rajasthan-s-deepening-water-crisis-116050300933_1.html

[31] Ibid.

[32]http://www.dhigroup.com/upload/publications/scribd/205941526-Rajasthan-Water-Distribution-DHI-Solution-IN.pdf

facilities within their premises.[33] Each day, around 32% families travel half-a-kilometre to fetch drinking water[34]. This water crisis is due to the declining groundwater levels. The water table has been declining by 33 cm per year over the past decade.[35] According to the state's Public Health Minister Kiran Maheshwari, "We (Rajasthan) are over exploiting groundwater. We withdraw 100 per cent water but recharge only 22 per cent. The government drills a tube well and it goes dry within three years. We install hand pumps that go dry within 8 months."[36] The impact of this decline of groundwater levels is causing higher concentrations of fluoride, iron, nitrates, arsenic, and brackishness in the water as shown in the graph below.[37] Immediate symptoms are digestive problems, skin diseases, and dental fluorosis.[38]



Source: WaterAid[39]

III. What are areas that struggle?

A. It is approximated that over 1 billion of the world's 5.4 billion people lack access to safe drinking water and 1.7 billion people lack access to adequate sanitation.

B. Only 77.8% of the Indian population has access to potable and adequate drinking water.[40] In Rajasthan, 38% of villages are facing a water crisis.[41]

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[33]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[34] ibid.

[35]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-has-least-availability-of-water-and-least-reliable-supply-Report/articleshow/18550029.cms

[36]http://www.ndtv.com/india-news/13-500-villages-in-rajasthan-run-out-of-drinking-water-as-crisis-deepens-1404220

[37] http://www.wateraid.org/~/media/Publications/drinking-water-quality-rural-india.pdf

[38] Ibid.

[39]http://www.wateraid.org/~/media/Publications/drinking-water-quality-rural-india.pdf

[40]http://documents.worldbank.org/curated/en/921311468041473929/pdf/717370WP0Box370WSP0Compendium0Water.pd

Access to tap water, which is much more convenient, is limited depending on the area. For example, in Uttar Pradesh and Bihar, less than 5% of households have access to tap water[42].

IV. What are areas that thrive?

A. A few states such as Punjab, Haryana and Uttar Pradesh have farmers making proper use of existing groundwater structures. The vast majority of states could use improvement in their water management conditions. A 2011 National Sample Survey Organization (NSSO) census found that 2.10% of the rural population had water supplies that were more than 500 meters from their homes.[43]

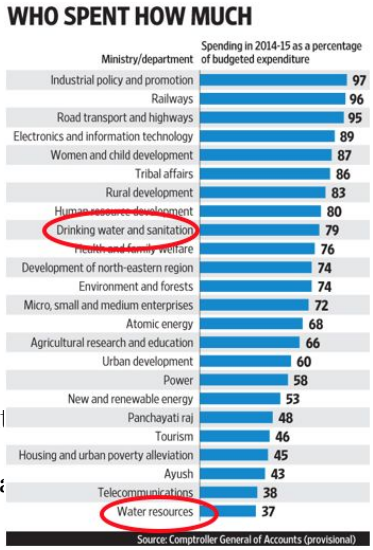
V. How does water become contaminated and why?

A. Water contamination in Rajasthan occurs when the water supply comes in contact with sewage or agricultural runoff. Birendra Singh, Union minister for drinking water and sanitation, there are 22,254 habitations that do not have access to potable water. There are 14 iron-affected habitations, 13,814 salinity (dissolved solids) affected habitations, 7,056 habitations affected by fluoride contamination, and 1,370 nitrate affected habitations which have not been provided potable water. Overall, water contamination in Rajasthan is caused by an excess of arsenic, fluoride, and iron in nature. Furthermore, nitrate contamination in drinking water is due to the excessive use of fertilizers and toilets. According to Birendra Singh, villages in Rajasthan are worst off in contaminated water compared to other villages in India.[44]

B. When people fail to wash their hands, or do not have access to proper sanitation, they become at risk for illnesses such as diarrhea. According to Water Aid[1], 140,000 children die each year from diarrhea due to contaminated water, while 383 people die from diarrhea due to contaminated water each day. 73 million working days are lost due to waterborne disease each year. The resulting economic burden is estimated at $600 million a year.[45]

VI. What do governments spend to transport potable water?

C. In order to provide potable water to villages in India, the government uses trucks to transport tanks of water to rural villages in India. This is a costly and inefficient process due to the amount of time and effort that is needed to fuel the truck,



[41] Ibid.

[42] http://ncw.nic.in/pdfreports/Women%20&%20Water.pdf

[43] http://www.mdws.gov.in/sites/default/files/Outcomebudget_0.pdf

[44] http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-con
eshow/48368621.cms

[45] http://www.wateraid.org/~/media/Publications/drinking-water-quality-rur

clean the water, maintain the truck, deliver the water, and drive to delivery locations. It is estimated that eight tankers are needed to sufficiently provide water to a village if the tankers make six trips each day in order to provide 200,000 litres of water. The use of eight tankers is excessively harmful to the environment, labor intensive, and an organizational hazard. [46]

D. Reports from 2014 and 2015 indicate that the government is only using 37% of its designated water management budget.[47] The graphic shown to the side, demonstrates the government's spending as percentage of budgeted expenditure. Since water scarcity and contamination are problems that plague many parts of India and affect the economy and healthcare, a bigger percentage of budgeted expenditures should be devoted towards drinking water and sanitation.
E. From the launch of the Five Years Plan in 1951 to 2016, approximately $16,572,944,700.00 US Dollars have been spent on providing safe drinking water[48]. This expenditure includes investing in clean water sources as well as providing potable water through trucks and government administration. The Five Years Plan plans out India's economy every five years.
F. Another main source of spending by the government on providing potable water is the National Rural Drinking Water Programme (NRDWPB), the main program of the Ministry of Drinking Water and Sanitation in India. This organization has invested Rs. 183,362 crore or over 27 billion USD, into the water sector since the development of the Accelerated Rural Water Supply Programme in 1972.[49] This program aims to accelerate the pace of coverage of drinking water supply. As an example of the budget, the NRDWPB budget for Rajasthan in 2015 was Rs. 353.13 crores or 51,465,025.95 USD given 0.15 USD is equal to 1 RS. The NRDWPB only spent 311.3 crores or 45,368,737.42 USD, which was less than budgeted.[50]

VI. What is India's water scarcity problem like?

G. Rajasthan has 10 per cent of the country's land mass but only 1.1 per cent surface water making it almost completely dependent on groundwater which is quickly depleting.[51]
H. The Rajasthani government says the state overexploited groundwater thus exacerbating the water scarcity problem. As evidence, groundwater levels

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[46]http://www.unicef.org/cholera/Annexes/Supporting_Resources/Annex_9/WHO-tn12_safe_water_tanker_en.pdf

[47]http://www.livemint.com/Opinion/VpODtln8lv3dEF9C8bYdUP/Government-spending-Numbers-dont-lie.html

[48] http://www.wateraid.org/~/media/Publications/drinking-water-quality-rural-india.pdf

[49] http://www.mdws.gov.in/sites/default/files/Outcomebudget_0.pdf

[50] http://www.mdws.gov.in/sites/default/files/Outcomebudget_0.pdf

[51]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

in 190 of the 236 blocks are either overused or critically short of water in. Blocks are used by the Ministry of Drinking Water and Sanitation to divide up Rajasthan districts into smaller areas. A full list of Rajasthan districts can be found at this link.

I. Only 791 per 1,000 households in rural Rajasthan have access to improved sources of drinking water while just 747 households receive sufficient drinking water throughout the year.[52] In urban areas of Rajasthan, 928 households per thousand have access to drinking water from improved sources but only 814 get it throughout the year. An "improved" drinking-water source is one that, by the nature of its construction and when properly used, adequately protects the source from outside contamination, particularly fecal matter.[53] The good sources of drinking water, typically in urban areas, come from pope water or protected wells and springs.[54]

J. The government is trying to address the current issues within water management in several ways. For one, the government now allows citizens to file complaints at indiawater.gov. Additionally, the establishment of the NRDWP in itself is an important step towards more efficient water management. In terms of water contamination, the Swachh Bharat Mission was allocated $26 million to work on universal sanitation coverage, improving cleanliness, and eliminating public defecation by 2019. The SBM is a national campaign by the Government of India, covering 4,041 statutory cities and towns, to clean the streets, roads and infrastructure of the country.

Educational Impact of Having Safe Water Available

Innovo Consulting researched the effects of the water crisis in India on education and government policies, finding that areas with clean water facilities saw higher enrollment rates for female students who no longer had the responsibility of collecting water for their families. The government is actively investing in water initiatives, making Aakash Ganga a desirable solution for many areas in India. Innovo Consulting used the following questions to evaluate the educational impact of providing clean water to communities in India.

I. Are there more people enrolled in schools?
   A. When areas have access to clean sanitation facilities and clean water, girls are no longer responsible for helping their mothers collect water, which

[52] Ibid.
[53] http://www.wssinfo.org/definitions-methods/watsan-categories/
[54]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

gives them time to receive an education. For girls, enrollment rates have improved by 15% or more when this occurs.[55] Additionally, literacy rates are almost 5 percent higher for women in villages with access to water, whereas there is no difference in the literacy rates of men. Furthermore, literacy rates of women in villages that have to travel far distances are lower than literacy rates of women in villages that do not have to travel far distances to obtain water.[56]

B. There are many personal examples of the effects of implementing potable water into villages. A woman named Shobha from Ajmer, Rajasthan said: "I walk three kilometres to fetch water. Sometimes we do three trips in a day. How many pots can I carry in one trip? My children are almost always thirsty and in this situation when we don't have enough for ourselves, can we give water to our animals?"[57] This quote shows how children are not able to focus on education when one of their most basic physiological needs are not met.

II. What other activities do people engage in if they are not fetching water?

A. Women in rural areas can walk a collective total of over 14,000 km per year to obtain safe drinking water. While women in urban areas travel shorter distances to retrieve water from taps on the roadside, they still have to spend hours waiting in line, and they have to make multiple trips to gather the water they need for the entire day. When they are not fetching water, women are usually cooking or cleaning, washing clothes or utensils, or looking after children or animals.[58] Since all of these responsibilities are usually delegated to women, having more accessible potable water not only makes finishing household chores easier, but also gives women more time for themselves. Offering new opportunities for women increases their recognition, strengthens their voice, and improves their quality of life.[59] This newfound independence can create educational opportunities for families by lessening the responsibility of children and giving the mother more time to complete household chores.

III. How are children affected educationally?

A. As a result of the water crisis, one in four girls does not complete primary school whereas one in seven boys does not finish their primary education.[60] Girls who do not join their mothers on trips to collect water usually take

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[55]http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf

[56] http://people.virginia.edu/~ss5mj/womenliteracyandwater.pdf

[57]http://www.ndtv.com/india-news/13-500-villages-in-rajasthan-run-out-of-drinking-water-as-crisis-deepens-1404220

[58] http://ncw.nic.in/pdfreports/Women%20&%20Water.pdf

[59] http://water.org/water-crisis/womens-crisis/

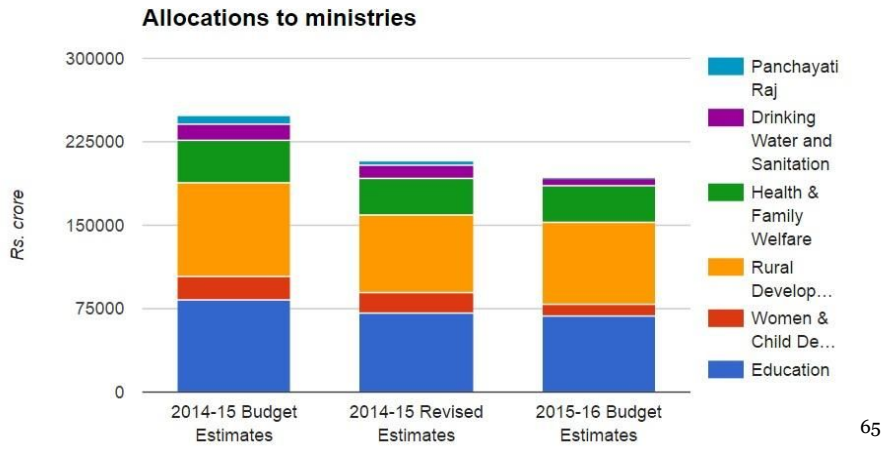
[60]http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf

care of the household and watch over siblings, leaving them no time to receive an education.[61] School enrollment rates for girls have been shown to improve by over 15% when provided with clean water and a toilet facility, since girls no longer have to walk miles every day to fetch water.[62] Once relieved of this burden, mothers not only have more freedom, but they also are able to assume more responsibilities in the household, allowing their girls to have the chance to receive an education.

IV. Does the government spend more or less when there is clean water?

A. Even though the Indian government has invested in the water supply system, water scarcity is still a big issue in many areas.[63]

B. As part of a fiscal plan written in 2012, India plans on spending Rs. 62.4 billion (~ $1 billion USD) by 2017 to help clean the water in 10,000 canals, lakes, and rivers. The government also plans on establishing "artificial replenishment and rainwater harvesting structures" in approximately 1 million km of India. These systems will capture the rain during the monsoon season, which provides India with 70% of its annual rain.[64]



[65]

V. Where can the government reduce its spending (health, economy, educational)?

A. Implementing Aakash Ganga will help the Indian government reduce spending on healthcare costs and boost the economy.

B. Aakash Ganga has the opportunity to align with the Mukhyamantri Jal Swavlamban Abhiyan (MJSA) campaign in the areas of village outreach and promoting village ownership of water conservation and harvesting programs. MJSA is a campaign launched by the Chief Minister of Rajasthan, Vasundhara Raje, in January 2016 that focuses on achieving self-sufficiency in water conservation in Rajasthan's rural villages and

[61] http://ncw.nic.in/pdfreports/Women%20&%20Water.pdf
[62] Ibid.
[63] Ibid.
[64] http://www.bloomberg.com/news/articles/2014-08-14/india-plans-to-spend-1-billion-to-clean-waters-by-2017
[65] Ibid.

communities. Aakash Ganga already has relationships with multiple villages in Rajasthan and promotes cultural integration and ownership of its water harvesting systems within those communities. Since the state has prioritized providing increased access to water for urban populations, Aakash Ganga is well-positioned as a solution that can alleviate government spending in rural populations.[66]

C. Capacity-building was identified by the World Bank Group as a key component for Rajasthan to improve its water supply and sanitation (WSS) services. Aakash Ganga has professionals trained as part of their IT network and engineers that use their automation tool to design the systems and manage the water quality of the reservoirs. Aakash Ganga can enrich its partnership with the government by training water management professionals in order to build capacity.[67]

Direct Economic Impact of Health Benefits

Implementing rooftop rainwater harvesting systems not only helps to alleviate the water crisis in India, but also has a profound impact on healthcare. This section outlines the effects of having clean water on health, the economy, and daily life.

I. What are the health benefits to drinking clean water?
   A. According to former government minister Birendra Singh, contaminated water is a prevalent problem in Rajasthan, due partly to over-fertilization, affecting 22,254 habitations as of 2015 that lacked access to safe drinking water. Water contaminated with arsenic, nitrate, fluoride, and iron poses serious health problems including skeletal fluorosis, which affects the teeth and bones and is difficult to diagnose early on. Fluorosis can lead to skeletal deformities, pain in the bones and joints, and even seizures and muscle spasms.[68]
   B. According to a 2014 report from the state of Rajasthan, surface and groundwater sources near urban centers are polluted as poorly managed wastewater runs into these water bodies and contaminates them. Rainwater harvesting systems avoid these unsafe water sources.[69]

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[66]http://www.thehindu.com/todays-paper/tp-national/tp-newdelhi/water-harvesting-conservation-movement-launched-in-rajasthan/article8161160.ece

[67]https://openknowledge.worldbank.org/bitstream/handle/10986/11902/709010ESW0v10P0C00WSSS0Report0Final.pdf?sequence=1&isAllowed=y

[68]http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms

[69]http://www.waterresources.rajasthan.gov.in/SPWRR/Report4.5.pdf

C. In addition, the spread of many water-borne diseases, such as diarrhoeal disease, can be mitigated through increased access to clean drinking water. According to the *World Health Organization*, implementing water quality intervention systems reduces the number of cases of diarrhoeal disease by 50%.[70]

II. Do health care costs decrease?

A. In 2006, according to the *Indian Journal of Occupational and Environmental Medicine*, poor sanitation conditions amounted to $54 billion USD, which was about 6.4% of the country's GDP. Of this figure, over 70% of the costs were related to health, with 12% due to diarrhea and respiratory infections. According to their study, in communities with decent sanitary conditions, improving the quality of drinking water could lower the concentration of fecal coliforms "by two orders of magnitude," resulting in a decrease of cases of diarrhea by 40%. The study also found that the greatest reduction in cases of diarrhoeal disease occurred when household and hygiene solutions were implemented. For example, effective handwashing techniques can lower chances of diarrheal illness by 30%.[71] A World Bank article indicates that India is still losing about 6% of its GDP due to unsanitary conditions.[72] By using Aakash Ganga, citizens will have access to more clean water, which will allow them to have more effective sanitary practices, thus reducing costs from poor sanitation conditions.

III. How is the water cleaner or safer?

A. According to the *Times of India*, in 2014, only 42% of households had bathroom facilities in rural Rajasthan. Also, 73% of people in rural Rajasthan had no toilet access. The report indicates that this figure is worse for states including Chhattisgarh and Jharkhand.[73] While it may not solve the issue of lack of bathroom facilities, implementing rooftop water

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[70]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[71] Kumar, Ganesh S., Sitanshu Sekhar Kar, and Animesh Jain. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/

[72] "Ending Open Defecation and Achieving a Clean and Healthy Rural India." *The World Bank*. March 30, 2016.worldbank.org/en/news/feature/2015/12/15/ending-open-defecation-achieving-clean-and-healthy-rural-india

[73] Sharmal, Saurabh. "Rajasthan touches rock bottom in drinking water, sanitation facilities." *The Times of India*. http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

systems can provide water sources for families, which can improve sanitary conditions within households. In response to an intense drought that hit the area in 2015, a campaign within Chhattisgarh implementing rainwater harvesting systems has begun. The village has installed over 400 systems with the goal of saving 400,000 liters of water annually. The campaign held small meetings, inspiring 200 village councils and self-help organizations to begin installing rainwater harvesting systems. Council offices have begun writing the names of people who have installed the systems on office walls to encourage more citizens to get on board.[74] This case study shows that Aakash Ganga can be a feasible solution to providing cleaner and safer water.

B. Many rooftop harvesting systems have elements that help provide clean and safe water, including a filter. A filter can be made of gravel, sand, and mesh can keep the rainwater clean in the storage tank, removing any silt or particles. After every rainfall, the filter should be cleaned. If the rainwater harvesting system is connected to an underground storage tank, all underground pipe systems must be evaluated to ensure that there is no leakage or contamination.[75]

IV. Will children live longer?

A. In India, between 400,000 and 500,000 children under the age of 5 years die due to a diarrhoeal illness, which results from hygiene issues.[76]

B. India's Millennium Development Goal wanted to reduce the Under-Five Mortality Rate (U5MR) by two-thirds by 2015. While the Infant Mortality Rate (IMR) and U5MR are declining, but not at a rate that will allow India to meet this goal. The Deloitte report on health care outlook for 2015 attributes high mortality rates partially to the lack of health care professionals in rural areas.[77]

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[74] Drolial, Rashmi. "Chhattisgarh's Balrampur beats water crisis through harvesting." *The Times of India*. July 17, 2016. http://timesofindia.indiatimes.com/city/raipur/Chhattisgarhs-Balrampur-beats-water-crisis-through-harvesting/articleshow/53248084.cms

[75] Madhya Pradesh Pollution Control Board. "Rainwater Harvesting." http://www.mppcb.nic.in/rwh.htm

[76] Kumar, Ganesh S., Sitanshu Sekhar Kar, and Animesh Jain. "Health and environmental sanitation in India: Issues for prioritizing control strategies." *Indian Journal of Occupational and Environmental Medicine*. 2011 Sep-Dec; 15(3): 93–96. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/

[77] Dhawan, Atul. "2015 Health Care Outlook India." *Deloitte*. https://www2.deloitte.com/content/dam/Deloitte/global/Documents/Life-Sciences-Health-Care/gx-lshc-2015-health-care-outlook-india.pdf

C. Access to clean water and improved hygienic practices will decrease the amount of cases of diarrhea, allowing children to be healthier and give them a better chance at survival.

Direct Economic Impact from Environmental Benefits

This section explains the environmental benefits of using the Aakash Ganga system, which includes reducing traffic due to decreased reliance on the tanker-truck system and the resulting economic benefits of less air pollution. An overview of the current state of water in the Rajasthan region and the economic and environmental effects of the lack of water is also covered. Some benefits of rainwater harvesting systems similar to Aakash Ganga are discussed.

I. How does the lack of pollution from trucks affect this system?
   A. According to Save the Water, a village in the state of Haryana with 7,000 residents paid an estimated $10.29-$11.76 USD for a tanker of water and $441 for water every day during a drought in 2014.[78] Former member of Parliament, Prasad Tanpure, reported in 2013 that more than 50,000 tankers of around 5,000 liters have been manufactured in the state of Marathwada in one year alone.[79] The *World Health Organization* details multiple recommendations to optimize the safety of using tankers to transport water, such as instructions for the cleaning and maintenance of these tanks, access ports screened with air vents, water pumps, and equipping tankers with chlorine kits to test the water.[80] The private-sector water tanker industry is mostly unregulated, so it is difficult to ensure that steel tankers are meeting these requirements, and as demand for steel tankers increases, more manufacturers are entering the industry unregulated.[81]
   B. According to the *World Health Organization*, one of the problems with transporting water by tankers is that they are heavy vehicles that can damage poorly constructed roads without reinforcement.[82]
   C. Current Tanker Truck Model

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[78]http://savethewater.org/2014/10/22/haryanas-budaak-village-lacks-drinking-water-decides-to-boycott-elections/

[79]http://www.thehindu.com/opinion/columns/sainath/tankers-and-the-economy-of-thirst/article4551597.ece

[80] http://wedc.lboro.ac.uk/resources/who_notes/WHO_TNE_ALL.pdf

[81] http://www.telegraphindia.com/1130416/jsp/nation/story_16790680.jsp#.WEBYj-YrLb0

[82] http://wedc.lboro.ac.uk/resources/who_notes/WHO_TNE_ALL.pdf

1. Under the utility model of water supply, utility-operated tanker-trucks deliver 20L of water per capita per day.[83]
2. These trucks, and trucks in general, are responsible for a significant amount of air pollution in India. 65% of all freight is transported by road in India, which results in severe traffic.[84]
3. Automobiles in general account for 40-80% of air pollution in India. Several Indian cities do not meet WHO guidelines for air pollution, and vehicular traffic appears to be the main reason for this.[85]

D. Economic Impact
1. According to a 2013 World Bank report, pollution (along with other environmental issues) costs India $80 billion annually, which is nearly 6% of its GDP.[86]
2. The report cited a survey of 132 countries which ranked India 126th for environmental performance and last for air pollution due to its power stations, traffic congestion, industry etc. Pollutants are released "as a by-product of exhaust emission, fuel evaporation during rifling and vehicle operation, and non-exhaust emission from brake wear, tire, and road surface wear."[87]
3. Reducing traffic from tanker trucks would reduce PM10 particulates (large dust particles). Cutting these particles by 30% would result in a 0.04% cut in the annual GDP, but "would save a total of $47bn-$105bn from reduced damage to human health and cut CO2 emissions by 30-60 percent."[88]

II. How does digging wells affect the water table?
A. According to Rajasthan's Public Health Minister Kiran Maheshwari, groundwater levels have been declining by 33 cm per year over the past decade.[89]
B. When the water table goes below eight meters, "Centrifugal pumps no longer work and farmers have to invest in submersible pumps—a much

[83] http://onlinelibrary.wiley.com/doi/10.1029/2009WR008693/full
[84] https://www.pwc.com/gx/en/capital-projects-infrastructure/assets/gridlines-india-article-2013.pdf
[85] https://community.data.gov.in/automobiles-and-pollution-in-india/
[86] http://www.ndtv.com/world-news/pollution-costs-india-80-billion-a-year-world-bank-528678
[87] https://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html
[88] https://www.ft.com/content/0a89f3a8-eeca-11e2-98dd-00144feabdc0
[89] http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-has-least-availability-of-water-and-least-reliable-supply-Report/articleshow/18550029.cms

more expensive technology."[90] This uses more electricity and causes the quality of water to decrease. Lots of these deep wells have "low and unreliable discharge, brackish water, and a high rate of failure."[91] Another alternative to the pumps is installing drip systems, but farmers have no incentive to change, so there is low interest.

C. This shortage and poor quality of water has led farmers to cultivate smaller parcels of land during the non-monsoon season; the cultivated area has decreased by 7% in the winter and 17% in the summer in villages where water is scarce. Farmers are now moving to cities and changing occupations due to this inconvenience.[92]

III. How is using rainwater effective?

A. In the Rajasthan region, the average rainfall for the state is about 570mm. A time period was not specified. (Innovo Consulting assumes that this statistic considers rainfall as each time that rain precipitates from the sky.) The amount of rainfall varies from the western desert region where there is 318.7 mm of rain to the eastern region where there is about 688.7 mm of rain.[93] However, 80-90% of the rainfall occurs in a three month monsoon season.

B. The following table describes average water rainfall in Rajasthan:

Period	Temperature	Rainfall
January to March	10 oC - 27 oC	4MM - 7MM
April to June	24 oC - 45 oC	11MM - 30MM
July to September	21 oC - 35 oC	100MM - 165MM
October to December	13 oC - 30 oC	3MM - 8MM

[94]

C. By using the rainwater, the excess rain from the monsoon season can be stored and used throughout the year. The Government of Rajasthan's Water Resource Development wrote on their website, "The concept of water conservation/harvesting has been practiced for ages in the form of tankas in homes, bawaries in the mohallas, khadins, johads and tanks in every village for the storage of precious water for drinking as well as

[90] https://wle.cgiar.org/thrive/2014/06/10/when-wells-fail-farmers%E2%80%99-response-groundwater-depletion-india
[91] ibid
[92] ibid
[93] http://www.waterresources.rajasthan.gov.in/SPWRR/Report4.5.pdf
[94] http://www.volunteeringinindia.org/climate-of-rajasthan.htm

agricultural purposes. Special attention is being given and more efforts for continuing the process and mobilisation of funds will be made. The possibility of participation from NGOs and the private sector will also be explored and implemented."[95] This excerpt demonstrates that the Rajasthan government considers rainwater storage an effective and proven way of collecting water, and supports Aakash Ganga's claims of offering villagers sustainable supplies of water.

Miscellaneous Information

IV. Rain Water Harvesting In Rajasthan

A. According to a 2014 ResearchGate publication about the Alwar district of Rajasthan in 2011, "If the RWH systems are installed in 50% of total household and all the public buildings, then 100% drinking water requirement of the entire area can be met by RWH alone. Approximate 4.0% domestic water requirement can thus be fulfilled by rooftop rainwater harvesting."[96]

B. In order to estimate the potential of RWH from a house, it is assumed that on average 25 square meters of clear roof area would be available per house. However, "The domestic water demand (DWD) and drinking water requirement (DWR) of the area has been calculated by assuming 135 litre per person per day demand for domestic use out of which 5 liter per person per day is water demand for drinking water use."[97]

Table 5: Water requirement fulfill from RWH

Houses with RWH	Percentage demand met from RWH	
	Drinking	Domestic
0 %	26.2 %	1.0 %
10 %	42.6 %	1.6 %
20 %	59.0 %	2.2 %
30 %	75.4 %	2.8 %
40 %	91.8 %	3.4 %
50 %	108.1 %	4.0 %

[98]

[95] http://waterresources.rajasthan.gov.in/vision.asp
[96]https://www.researchgate.net/profile/Kuldeep_Tiwari/publication/274581526_Rooftop_Rain_Water_Harvesting_as_Part_of_IWRM_Plan_of_Khuskera-Bhiwari_Neemrana_Investment_Region/links/55239d420cf29dcabb0f0706.pdf
[97] ibid
[98] ibid

Table 4: Domestic water requirement per person

S. No.	Description	Amount of water (per person per day in litres)
1	Bathing	55
2	Washing of clothes	20
3	Flushing of W.C.	30
4	Washing the house	10
5	Washing of utensils	10
6	Cooking	5
7	Drinking	5
Total		135

Source: IS 1172 (1993)

[99]

C. Although there are many benefits of having this water, there are concerns that rainwater has lots of metals and impurities.[100] In many states and countries, the rainwater is not used for consumption; it is used for agriculture and toilet flushing.

State of Water Availability in India

I. In India, 5.5 percent of the country's geographical area and 7.6 percent of the population are facing acute in water storage, with availability less than 500 cubic meters.[101] The main factors that affect potable water are the misuse of water, inadequate rainfall, and the release of pollutants.

II. Some of the states in India depend on groundwater for 50% of their water sources, while India on average depends on groundwater for 45.78% of its water source.[102]

III. About 1,122 billion cubic meters are estimated to be used by the Indian population to obtain potable water, but only 605 billion cubic meters have been used.[103]

[99] ibid
[100] http://www.who.int/water_sanitation_health/gdwqrevision/rainwater.pdf
[101] http://medind.nic.in/haa/t08/i1/haat08i1p47.pdf
[102] Ibid.
[103] Ibid.

IV. Total precipitation on Indian landmass, including snow and rainfall, is 4,000 billion cubic metres. The estimated runoff in India is 1,869 billion cubic meters. [104]

V. The follow table gives the sector wise utilization of total water resources in India

Sector-wise utilization of total water resources in India

S. No	Purpose	Percentage
1.	Domestic	4.9
2.	Industries	3.3
3.	Irrigation	82.9
4.	Power generation	3.3
5.	Others	5.6
	Total	**100.00**

[105]

VII. The next tables provides past and estimated water requirements:

WATER REQUIREMENTS

Use	2000	2010	2025
Domestic	30	56	73
Irrigation	501	688	910
Industry	20	12	23
Energy	20	5	15
Other	34	52	72
	605	813	1093

(Figures in billion cubic meters)

[106]

IX. "The annual per capita availability of freshwater in 1961 was 5,177 cubic meters, which declined to 1,869 cubic meters in 2001. It is likely to fall further to 1,341 cubic meters in 2025 and in 2050; it will be 1,140 cubic meters. It is generally presumed that if per capita level falls to 1,000 cubic meters, it could seriously affect the health and economic activity of the entire country of India."[107]

Costs of Other Programs that Provide Potable Water

I. Alternatives to solving the issue of the water crisis include desalination of seawater and interbasin transfers, but these methods can be costly.[108] Although implementing a fully functioning piped water supply system within a home will

[104] Ibid.
[105] Ibid.
[106] Ibid.
[107] http://www.hgsitebuilder.com/files/writeable/uploads/hostgator427959/file/ijars351.pdf
[108] Kumar, Ganesh S., Sitanshu Sekhar Kar, and Animesh Jain. "Health and environmental sanitation in India: Issues for prioritizing control strategies." *Indian Journal of Occupational and Environmental Medicine*. 2011 Sep-Dec; 15(3): 93–96. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/

maximize health benefits, this is the most expensive solution. According to a *World Health Organization* report from 2007, implementing a piped water system could cost between $48 to $60 billion for a ten year period. For countries with low financial resources, implementing protected wells and pit latrines may be a more feasible choice to improve the sanitation situation. Aakash Ganga is a potential affordable solution to this issue. Health benefits and access to clean water will contribute to substantial time savings, which translates to an improved household economy.[109]

[109] Haller, Laurence, G. Hutton and J. Bartram. "Estimating the cost and health benefits of water and sanitation improvements at global level." *Journal of Water and Health*. 2007 Dec;5(4):467-80. http://jwh.iwaponline.com/content/ppiwajwh/5/4/467.full.pdf
[4]http://www.who.int/mediacentre/multimedia/2002/ind_sanitation/en/

Website Recommendations for Sustainable Innovations

Sustainable Innovations is currently in the midst of redesigning their website in order to make it more user friendly, easier to read, and aesthetically pleasing. Innovo Consulting analyzed SI's website by interacting with the website and testing out its usability, keeping in mind how the interface would appear to potential donors. Innovo Solutions analyzed the website by interacting with each section/page of the website.

a. Overall Website:
    i. Bottom Footer of the "General" Webpage: The Facebook and social media links is are distorted and contain no recent posts, which reflects badly on the social media presence of Sustainable Innovations since they have social media posts on their accounts.
        1. In order to solve this, a link to Facebook may provide users a way to get to the Facebook, instead of viewing an empty feed on the webpage.
    ii. When pressed, the phone button on the top of the page does not call and the phone number provided does not appear to be complete.
    iii. The wording on each section does not seem to be formatted correctly. We would recommend aligning the text left, right or center, instead of justified in order to avoid words running off onto the next line.
    iv. The archives on each webpage seem to be redundant. It may be beneficial to only provide archives on one webpage or create a separate webpage on the Sustainable Innovations website that contains archived information. Additionally, the archive links have repetitive information once the links are clicked.
    v. If the window is not fully open that a user is viewing the webpage, then formatting is skewed.
    vi. The color scheme of the Sustainable Innovations website seems slightly polarizing using gray, hot pink, lime green and black, Innovo Solutions suggests using beige, grey, white, and blue because these colors are more neutral and they can be associated or symbolic of water in India.
    vii. On the landing page of the Sustainable Innovations website, the photo speed of the slideshow could be distracting to viewers because of the fast transition pace.
b. "About SI" Section:
    i. The formatting on the webpage seems to be formatted strangely. This could be improved by changing the margins
c. "Partnerships" Section:
    i. This web page is very informative because it gives insight into the people who are leading the organization, although it has inconsistent formatting

under the description of Debra Cheng. This problem could be fixed by adding additional text to the description of the board member.

d. "Gallery" Section:
    i. The photos on this section are informative and valuable, but they seem scattered and unorganized. If the photos were organized in an organized row with clear and uniform descriptions, this would improve the aesthetic appearance of the webpage.
e. The "Triage @ Home" Section:
    i. This section of the webpage flows well with quality information about the program, but could be improved aesthetically with better spacing. Additionally, to improve the aesthetic appearance of the webpage, the data portrayed on this page could be formatted according to a table with lines in order to make the presentation of the data more clear and easier to read.
f. Aakash Ganga Website
    i. Transition from Sustainable Innovations Website: A user is taken to different places depending on whether they click on the "Current Installations" section or the heading "Aakash Ganga." This can be confusing for some users. The current installations options leads to Aakash Ganga's own web page, while there is only a summary of Aakash Ganga if the "Aakash Ganga" section is clicked.
        1. It may be beneficial to simply link users to the homepage of Aakash Ganga in order to provide users with a wealth of information about the project, including the current installations. If Sustainable Innovations would like to include a summary of Aakash Ganga on their website, Innovo Consulting suggests including a link to Aakash Ganga's own webpage as well as informing users of the webpage at the top of the "Aakash Ganga" section in order to provide users more information about the system.
    ii. "Project Overview" Page:
        1. The data in this section is very insightful to the user about current installations of the system, but the watermark can be distracting while reading the data. The data seems to be formatted in an organized and informative matter. Additionally, the ability to filter the data is helpful.
    iii. "Home" Section:
        1. The homepage of Aakash Ganga's web site is aesthetically pleasing with the the quote and the photograph at the beginning. Also, the Aakash Ganga summary with statistics is extremely helpful and informative at the bottom of the page. Since the data seems

extremely educational, Innovo Solutions suggests moving up the the placement of the section in order to provide users with a holistic view of the project as soon as the arrive at the homepage. Innovo Solutions appreciates the "Our Approach" section of the webpage because it gives a clear visual image of the Aakash Ganga system and informs users about the Rainwater Harvesting, Social Audit, and Upkeep Services of the system.

iv. "About" Section
    1. This section of the Aakash Ganga website is clear, explanatory, and informative. This is Innovo Solution's favorite page because it gives a clear and helpful explanation of what the Aakash Ganga program values and the objectives of the program.
    2. The photos, numbers, and information on each of the section are very informative.
        a. Innovo Solutions found two formatting errors that can fixed in order to improve the aesthetic of two of the subheadings on the page. The "Engineering Innovations" page has formatting errors due to a random quote at the bottom of the page, which may be confusing to some users. The "Phase I" subsection is not aligned correctly and the spacing between words seems to be misaligned.

v. "Social Audit" Page
    1. This section of the Aakash Ganga website seemed confusing to Innovo Consulting. In order to improve this section of the website, Innovo Solutions suggests creating an introductory webpage for the section heading, with an explanation of the three subcategories.
    2. Innovo Consulting suggests creating a portal for users India to track their data, usage, and maintenance. This creation could differentiate users who are coming to the website to find out more about Aakash Ganga from those who are visiting the site in order to find out or update information about their own system.
    3. This initiative may have already been started with the "Login" button, but the "Login" button is not functional when clicked on.

vi. "Library" Section
    1. This section of the Aakash Ganga seems to be under heavy construction still. However, the media coverage section is very informative and organized in aesthetic. Innovo Solutions promoting this media more by putting this media on the homepage in the middle or bottom of the page in order to provide users with positive

media coverage that the program has received. The Best Practices section is organized in an efficient and aesthetically pleasing manner.

2. A few errors that Innovo Solutions observed is the misspelling of Rajasthan on the drop down menu and a lack of information in the case study section.

Overall, the Sustainable webpage has been improved significantly from its previous version. The most pressing suggestions are fixing the alignment of text and some formatting issues. Misalignments and formatting issues are important to fix because they affect the aesthetic of the website. The Sustainable Innovations webpage's aesthetic appeal is very important because it is the first point of contact that many potential donors may have with Sustainable Innovations. Thus, it is very important to provide a clean, informative, organized, and positive image of Sustainable Innovations to web page viewers. In addition, making minor changes to the Sustainable Innovations webpage, Innovo Consulting suggests promoting the Aakash Ganga webpage with greater efforts because the website has great and organized information about the rainwater harvesting system.

Recommended Reading Sources

Innovo Solutions has identified sources that were referenced frequently throughout our research. These may be useful sources of information by providing additional information to the topics discussed in this deliverable.

a. Indian Journal of Occupational and Environmental Medicine
    i. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/
b. Journal of Water and Health
    i. http://jwh.iwaponline.com/content/ppiwajwh/5/4/467.full.pdf
c. UN Water (for Women)
    i. http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf
d. Report on Women and Water by Research Foundation for Science - Technology and Ecology
    i. http://ncw.nic.in/pdfreports/Women%20&%20Water.pdf
e. The World Bank
    i. http://www.worldbank.org/en/news/feature/2015/12/15/ending-open-defecation-achieving-clean-and-healthy-rural-india
f. Government of India's Outcome Budget of the Ministry of Drinking Water and Sanitation

    i. http://www.mdws.gov.in/sites/default/files/Outcomebudget_0.pdf
g. CGIAR Water, Land, and Ecosystems:
    i. https://wle.cgiar.org/thrive/2014/06/10/when-wells-fail-farmers%E2%80%99-response-groundwater-depletion-india
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i. Water Aid:
    i. http://wateraidindia.in/
j. The Times of India: Rajasthan Worst-hit by Water Contamination
    i. http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms

Conclusion

Overall, the Rajasthan region has been adversely affected by water contamination and water scarcity. This has left 19 out of the 33 districts are affected by famine and nearly 17,000 out of the 44,672 villages in the state facing a water crisis. Further more, each day, around 32% families travel half-a-kilometre to fetch drinking water[110]. The implementation of an Aakash Ganga System in a Rajasthan village can provide clean water access to around 271 households on a regular basis. Additionally, the implementation of Aakash Ganga saves $38,645,029.19 over 25 years in comparison to using truckers to transport water. The Aakash Ganga system is able to make a positive contribution to the Rajasthan state due to its sustainability, low cost, ability to harness rainwater, low maintenance costs, and its integration into local culture. One potential downfall is the system's dependence on rainfall, although in combination with rainfall statistics found in the deliverable and storage statistics that Sustainable Innovations has, this may not be a problem to many areas of Rajasthan. One of the best social advantages of Aakash Ganga is the freedom that it can give women, who are usually tasked with getting water. If Aakash Ganga was implemented in all of Rajasthan 65,552,526 households would no longer be dependent on women to obtain their water supply, which would increase the freedom of women in society. This would translate in 3914 working days saved and a RS 3817.83 or USD 3817.83 savings in the economy.

[110] Ibid.

Appendix

Data used in Calculations:

1. Calculation 1: For 76% of households in India, women are responsible for gathering water for their families. Because women are spending a majority of their days collecting water, India is losing 150 million workdays per year which translate to a 10 billion rupee loss ($160 million in U.S. dollars)[111]
2. Calculation 2: Due to a dramatic decrease in rainfall of 20-60% rainfall in 16 of Rajasthan's 33 districts, many people in Rajasthan have resorted to private suppliers[112]. The majority of these suppliers only provide water every eight days. The suppliers charge RS 300 or $4.32 USD at an exchange rate of 68.62 RS for 1 USD for 3,000-4,000 litres per week.[113]
3. Calculation 3: Only 791 per 1,000 households in rural Rajasthan have access to improved sources of drinking water while just 747 households receive sufficient drinking water throughout the year.[114]

Potential Data for Calculations:

A. Throughout Rajasthan, 19 out of the 33 districts are affected by famine, and nearly 17,000 out of the 44,672 villages (38% of villages) are facing a water crisis. In parts of rural Rajasthan, only 39% households have drinking water facilities within their premises.[115] Each day, around 32% families travel half-a-kilometre to fetch drinking water[116]

B. Women in rural areas can walk over 14,000 km per year obtaining safe drinking water.[117]
C. As part of a fiscal plan written in 2012, India plans on spending Rs. 62.4 billion (~ $1 billion USD) by 2017 to help clean the water in 10,000 canals, lakes and rivers.[118]

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[111]http://www.unwater.org/fileadmin/user_upload/worldwaterday2015/docs/Water%20For%20Women.pdf

[112]http://www.business-standard.com/article/economy-policy/rajasthan-s-deepening-water-crisis-116050300933_1.html

[113] Ibid.

[114]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[115]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms

[116] Ibid.

[117] http://ncw.nic.in/pdfreports/Women%20&%20Water.pdf

[118]http://www.bloomberg.com/news/articles/2014-08-14/india-plans-to-spend-1-billion-to-clean-waters-by-2017

D. According to government minister Birendra Singh, contaminated water is a prevalent problem in Rajasthan, due partly to over-fertilization, affecting 22,254 habitations as of 2015 that lacked access to safe drinking water.[119]
E. According to the *World Health Organization*, implementing water quality intervention systems reduces the number of cases of diarrhea by 50%.[120]
F. In 2006, according to the *Indian Journal of Occupational and Environmental Medicine*, poor sanitation conditions amounted to 54 billion USD, which was about 6.4% of the country's GDP. Of this figure, over 70% of the costs were related to health, with 12% due to diarrhea and respiratory infections.[121]
G. According to their study, in communities with decent sanitary conditions, improving the quality of drinking water could lower the concentration of fecal coliforms "by two orders of magnitude," resulting to a decrease in cases of diarrhea of 40%.[122]
H. According to Save the Water, a village in the state of Haryana with 7,000 residents paid Rs 700-800 for a tanker of water and Rs 30,000 for water every day during a drought in 2014.[123]
I. Under the utility model of water supply, utility-operated tanker-trucks deliver 20L of water per capita per day[124].
J. Reducing traffic from tanker trucks would reduce PM10 particulates (large dust particles). Cutting these particles by 30% would result in a 0.04% cut in the annual GDP, but "would save a total of $47bn-$105bn from reduced damage to human health and cut CO2 emissions by 30-60 per cent"[125].

Please refer to "Cost Calculations" Spreadsheet to see how numbers were calculated.

[119]http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms
[120]http://timesofindia.indiatimes.com/city/jaipur/Rajasthan-touches-rock-bottom-in-drinking-water-sanitation-facilities/articleshow/28719982.cms
[121] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3299104/
[122]http://timesofindia.indiatimes.com/city/jaipur/Raj-worst-hit-by-water-contamination-Minister/articleshow/48368621.cms
[123]http://savethewater.org/2014/10/22/haryanas-budaak-village-lacks-drinking-water-decides-to-boycott-elections/
[124] http://onlinelibrary.wiley.com/doi/10.1029/2009WR008693/full
[125] https://www.ft.com/content/0a89f3a8-eeca-11e2-98dd-00144feabdc0