Identifying Factors Promoting the Use of Purification Technology

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Table of Contents

Acknowledgements

Reflection:

In any internship experience it is expected to have a learning curve as one starts to gain understanding of how research is conducted and balance the new professional environment with the school environment once known. When discussing with my mentors what research I would be conducting I continually had to alter my project due to the limited time I was there, the limited resources available to the Seghal Foundation, or the limitations due to my ability as high schooler. From this I learned how the sharp structure that is so commonly thought of when developing scientific research is non-existent in the developmental world. The flexibility is needed to bring about a significant, impacting and accurate study, forcing the researcher to understand the holistic problem rather than only focus on singular aspects. The chaos that is India, seeped its way into my work's development, and without such an influencer my research would be flat and useless. This idea is one that I will continue to keep close with me, as no one can enter somewhere thinking they have a perfect answer, if solutions are to be found learning must take place.

Credits:

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Research: Abstract

In India the variance of water quality differs with each source, level of use by community, and geographic location. Due to this variance there is a broad range of contaminates that compromises drinking water, causing increased levels of health issues. The Bio-sand Filter (BSF) was first invented in the 1980s and has since been improved upon by the Sehgal Foundation with their Jalkalp Model. Made of stainless steel at a cheaper rate and higher durability, this model offers better performance and longevity in the field while still providing the health benefits found in the original model. These benefits include removal of bio contaminates like the E. Coli bacteria, viruses, iron, and arsenic. Prominent levels of arsenic, iron, and other biological impurities in water cause sickness, death, financial strain, low levels of ability to develop. This is simple solution that with wide spread implementation will have a vast beneficial effect on the home it resides in. While these benefits are found under multiple studies done by both the Sehgal Foundation and independent researchers, the user's recognition of these benefits is unknown. In order to determine the perceived level of benefits the user experiences, a questionnaire coupled with observational analysis of in field use serves to determine what factors of the BSF are most noticeable and what aspects need increased education to the user to better their understanding of the importance of such a unit. /findings/

Introduction

Water filtration units, such as the bio-sand filter (BSF), successfully removes biological impurities, and heavy metals such as iron and arsenic, preventing short and long-term illness in the user's household. Bio-sand filter was originally created in the 1980s by a Canadian engineer Dr. David Manz who relied on filtration concepts found near geographic areas of freshwater. In the original design, the structure was constructed of concrete and filled with fine sand and gravel. When water is poured on the top of the filter particulate matter is trapped at the surfaces on a biological layer. Due to the fragility of a concrete structure quality control during manufacturing and transportation led to multiple cracks, other breakage and caused filters to be unusable. With the use of a steel structure offered an alternative that was more affordable, reliable, and durable while in field use, continuing to fulfill the objective of filtering contaminated water.

Through multiple studies it has become evident that the Jalkalp model of the bio-sand filter (BSF) helps to satisfy problems that occur from the original design made of concrete or of plastic. This research is designed to evaluate what specifics aspects of the bio-sand filter are perceivable to the user. The benefits from the reduction in pathological illness, viruses, exposure to harmful substances like arsenic and iron, turbidity, and economic advantages are factors that are at the focus of this study. The perceived benefits and disadvantages can then be used to alter the education, promotion and design of the BSF to be better applicable in field use.

Method

Because of the exploratory nature of this study, the researcher chose a case study approach with two case studies, a qualitative analysis of the BSF use in Nuh and a quantitative analysis of the BSF in Bihar.

Nuh: Fifteen households, from Bajitpur Sejatpur and Madhi, in the Nah and Tauru tehsils, were interviewed about their past and present water filtration practices. Eleven of the participant population were previous users of a BSF unit, but none of the interviewed currently used the system. Five focus groups and two participant households were interviewed from the villages of Ramiyala, and Ter Mohammadpur. Three of the focus group mainly consisted of women, while the other two had no women present. Those interviewed from these villages had no water filtration practice, and their responses were collected to determine what aspects of the quality of water is most important to the participants. Participants were asked to describe their water collection and purification practices by the researcher with the assistance of a translator. Interviews were conducted in a household setting.

Bihar: At the time of the study BSFs were present in the state of Bihar for 15 months. 100 houses with BSFs were interviewed and 50 households without BSF. Both groups answered a questionnaire that focuses on factors like family income, perceived benefits of the BSF, and exposure to use of the unit by others. Questionnaires were sent to participant by an associate in the field, and were filled out onto a paper copy. Two questionnaires were be presented, one for households that have a BSF and one for those who do not. Questionnaires were complete with the assistance of a translator in discussion with the participant.

Results: Nuh Case Study

In all the visited villages for the qualitative case study the water from handpumps and bore wells were noticeably saline, and sweet water was extracted from few households who had access to or agreements with neighbors for drinking water. In all the villages there were reports of stomach aches, vomiting, skin rashes, and headaches. There was also a prevalence among the participants of noticing negative effects the water had on agriculture, irrigation practices and livestock health. In Bajitpur Sejatpur and Madhi, the interviewed households who no longer use the BSF, the reason for is abandonment ranges from maintenance issues and breakage of the unit to personal preference. The shortest amount of usage time of the BSF system was 2-3 months, while the longest usage time was 4-5 years. Of the eleven previous owners of the BSF, six of them stopped usage due to breakage of the system. Most of these cases were cracks in the shell, as well as spout failure. Other issues reported were the improper use of filtering materials, lack of stoppable valve on the unit and the perceived idea that water source for drinking did not need purification. Four of the household interviewed did not own a BSF and either used another purification method or drank water straight from the source. Of the interviewed households, nine homes relied on hand pumps near the home for drinking water, six relied on bore wells, and three relied on tap systems. This water was found to have levels of iron and biological contaminants.

Eight of the households that had a BSF but no longer use the unit, do not purify water through any method. The issue of members of the household continuing to drink water straight from the source, and not exclusively from BSF caused a household to believe that the BSF was not an effective filter and did not reduce sickness. Because of this belief, there was no perceived benefit of filtration thus the household stopped all filtration practices after the BSF. The three other households that had a BSF but no longer use the unit use other purification methods like cloth

filtration, an alternative filter or boiling drinking water. Half of the homes without a BSF unit relied on other filtration units such as RO filter and Aquaguard. The other have of this interviewed population do not filter drinking water via any method. Causes for complaints of the BSF by previous users was its constant flow. In one household, the head specifically cited the inconvenience and cause of contamination due to the BSF open valve. At two other homes, heads cited the convenience of having a water holding system that had a controllable valve that would keep insects and other contaminants from entering the water.

Within the villages of Ramiyala, and Ter Mohammadpur, where no water filtration was practiced, the interviewed participants used bore-wells and hand pumps near to their home. Some of the bore-wells were known in the village to have “sweet water” and villagers would use these sources for drinking water exclusively. In these villages chlorine tablets have been distributed through ICDS centers, however, villagers discontinued use due to the smell of the water after treatment. When a member of the household gets sick, only then do the heads of household boil or purchase their drinking water. In the village of Ter Mohammadpur, their main drinking source is a canal outside the village. This drinking source is extremely polluted with biological contaminates from factory waste pumped in through a drainage pipe. This factory waste comes from a mean processing plant a kilometer away from the village. The pollution has reached a point where the village continually has a putrid smell and the villagers have developed skin rashes and other ailments. Reasons indicated by the focus groups interviewed for not purifying their water is lack of education on why or how to conduct water purification, as well as the inconvenience that most purification methods pose. Due to the time needed to be allocated to water purification or the funds needed to support continued practiced filtration many households do not participate in water purification.

Results: Bihar Case Study

Of the respondents, those who are non-users of Jalkalp had a lower amount of income per-capita than the user group. Respondents of the non-user group made an average 18,878 per-capita income, while the user respondents had an average 23,535 per-capita income. The primary source of income for the non-user group was 36% agriculture and 36% labour (n=50) while user respondents' primary source of income was 82% agriculture and only 6% labour (n=100). When asking the Non-user respondents what the factors were affecting there choice to not purchase a Jalkalp 69% of them stated it was because of cost. Of both the user and the non-user respondents both had a majority rely on personal handpumps that were close in proximity to their home (Non-users 92%, Users 97%). When questioned about the respondents' perceptions of the quality of water that they use those without Jalkalp are unaware of issues in water quality and see no need for filtration as >70% ranked their water quality as "Fit for Drinking" or "Drinkable with little quality concerns." Respondents that are users of Jalkalp have a heightened awareness of the poor quality of water, including the user respondents who have discontinued use. Since the discontinuation users who do not filter with Jalkalp rely on RO water, Aquagaurd and a tap water scheme in the area. Among Non-users, only 26% of respondents are found to be aware of what the 'Jalkalp' bio-sand filter is. Among the people who are still using Jalkalp, 78% use water from the filter exclusively, while others consume and use supplemental non-filtered water. The motivating reasons for purchase among the continued users (n=89) consisted of 49% of the respondents stating that Jalkalp would filter water to taste better. Between the two genders in the user's population, both indicated that taste was the most important benefit of Jalkalp, but 18% of men stated that filter water enhanced cooking while women felt that the purity of the water and the color was the second most important benefit (20%, 33%). Within the studied population of

both non-users and users, the reported incidences of water-borne diseases were less than 5% and thus incomparable. However, when asked, 80% (n=100) of the user population stated that they perceived Jalkalp to reduce the frequency of illness and reduced the health expenditure. The highest reported reason for the discontinuation of use (n=11) was because of leakages and damage to the Jalkalp (45%). Within the users' population, a third of the respondents stated they had no problem with the Jalkalp. Among the continued users the most frequent complaints of Jalkalp was the issues with doing maintenance and design issues like lack of temperature control, immobility and need to use a bucket to catch the continued flow of water from the valve.

Discussion: Nuh Case Studies

In Bajitpur Sejatpur and Madhi it can be determined that the implementation of the Jalkalp BSF is likely to satisfy the issues cited by household interviewed. Of the households that owned a BSF, a majority of them stopped uses due to a breakage of the cement shell. Without the fragility of the concrete BSF, the units' longevity would increase, continuing to supply that household with filtered water. Along with the Jalkalp, the partnered use of a container that the BSF drips into with a valve will stop the constant flow and decrease the insect contamination. Reintroduction may be needed in these areas as many of the BSF were bought before the invention of the Jalkalp and does not have the necessary education to better use the unit and increase its' longevity. The continued importance being placed on the need for filtration will likely increase the public opinion of the BSF unit and increase purchase in these communities. Along with standard education about maintenance and use of the BSF education pertaining to other filtration methods will over increase the health of the villagers whether or not they are able to afford a BSF unit.

In the present study, it has been observed that the success of the BSF is often hindered by the fragility of a concrete model, the inconveniences from the constant stream and lack of benefits being perceived due to the need for education, be it with improper maintenance or misunderstanding of the importance of filtration. An innovative use of the Jalkalp model of the BSF is the best line of defense against not only contaminated water but also against the previous complaints of the BSF.

In the villages of Ramiyala, and Ter Mohammadpur, increased purification methods are needing to combat the inadequate quality of water available in these villages. While Jalkalp is a viable solution other action must be taken to properly protect the main canal. Continued action

by the protesters on governmental leaders and added pressure from negative media exposure could lead to the factory changing its disposal practices. Reliance on purchases water is extremely prevalent in the second village interviewed, yet this is an option only available to those who have the ability to afford RO water. Jalkalp is a viable solution as it would be able to reduce the biological contaminants in the water and would reduce the amount of fund needed to purchase drinking water. A factor inhibiting wide response in Ter Mohammadpur is the lack of ability to afford a BSF and the fact that even if every household filters their irrigation and livestock will still suffer. In Ramayana, villagers are largely unaware of the issues in their drinking water, even if it considers ‘sweet.’ Without this understanding, they will not feel a need to buy a BSF or practice any other filtration methods. The Jalkalp model will prove to be more successful if implemented because of its durability and reliability if properly maintained.

Discussion: Bihar Case Study

The bio-sand filter is a scientifically proven successful water purifier in control environments, but in order to ensure the effectiveness, scalability and sustainability reinforcement of education discussing the health implication of consumption of poor quality water, the proper maintenance of such a system, and how to fix damages is key. These problems can be solved with simple tactics like water quality meetings held in communities, distribution of informational pamphlets and allocation of community members whom villagers can turn too with questions. Along with these issues, the reduction of the upfront cost of payment through installments would allow those on the low economic class to be able to afford a filter. Finally, experimentation on design changes to the Jalkalp could allow better implementation in the field. The addition of a stoppable tap on the valve of the system, wheels that would allow mobility or temperature control of the water that is filtered would satisfy the most common complaints by users. Overall the benefits of the Jalkalp are being felt by the respondents in this study but this perception is dependent on the proper education and maintenance of such system in order to ensure successful implementation.

Conclusion

Both qualitatively and quantitatively the participants in these case studies were aware of the low-quality water sources they used yet a majority still chose not to practice any water purification methods. Of the has participants that used the BSF they perceived many benefits such as health benefits, or economic advantages. However, venerability of the bio-sand filter and the Jalkalp model has hindered it's success in field use. Possible recommendations and notes as found through these case studies include allowing the BSF to be mobile, this could be satisfied through the addition of wheels or through decreasing the weight of the system. Along with this, the addition of a controllable tab will decrease the recontamination due to the water having to constantly flow into an open bucket. Also pertaining to alterations to the device, temperature control of the water will increase the attractiveness to the user and combat this issue that comes with the stainless steel model. To positively effect the scalability of BSF use, use of awareness sessions on the health impacts of not purifying water will give people the information needed to understand what risks they are taking drinking from their current sources. Finally in increase the longevity of such a model, continued education and damage solutions are needed so the users of the BSFs can respond properly is there is an issue without compromising the system. Overall, the health and economic benefits of the BSF is perceived by the users of such a system, but without the education and increased awareness of such solutions, sustainable water purification will not take place.

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