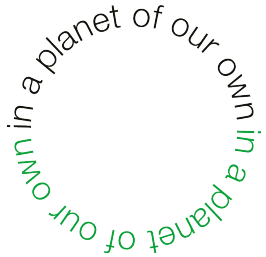

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Designing sustainable clean water solutions using women's livelihood generation and empowerment strategies

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Abstract: According to the United Nations, 783 million people lack access to clean water, and of these, 3.5 million die every year as a result of inadequate water supply, most often related to poor sanitation and hygiene. While there are thousands of solutions that have been developed for cleaning water in various parts of the world, from high-tech chemical processes to low-tech filters, the problem of unsafe drinking water still persists. This paper argues that one of the reasons for this disconnect between the problem and proposed solutions lies in a lack of sustainable models for distribution and adoption. Using a Canadian-led research project based in South Goa, India, called CleanCube, as the backbone of this discussion, the paper explores how sustainable clean water solutions can be designed by leveraging income generation and women's empowerment activities. CleanCube employs these strategies in migrant slum communities where the need for clean water and improved sanitation goes hand in hand with a lack of economic and social enfranchisement opportunities, especially among women.

Keywords: Social innovation design, Participatory design, Design for sustainability, Social enterprise, Systems design, Clean water, Women's empowerment, Income generation

1. Introduction

Worldwide, 783 million people lack access to clean water. Of these, 3.5 million die every year as a result of inadequate water supply, most often related to poor sanitation and hygiene (UN Water, 2013). According to UNICEF, in India alone, "approximately 600,000 children die annually due to diarrhea or pneumonia, often caused by toxic water and poor hygiene" (Harris, 2013). For many children who survive, stunted growth and cognitive impairment continues to impact the rest of their lives, shaping their social and economic opportunities (UNICEF, 2008).

The sad irony is that water-cleaning devices are available, particularly in India where cheap manufacturing abounds. Wall-mounted filtration units with replaceable ceramic filters, like those often found in a North American or European home, are available for purchase in India as well. There is also cheap bottled water available from local stores and gadgets like those that attach to a water tap, which are sometimes sold by door-to-door peddlers. All promise cleaner water; some are more effective than others and are offered at different price points. With a plethora of water cleaning options available, why are so many people still lacking access to clean water?

1.1 The challenge of clean water

As with other challenges in India, the answer is complex and often relates back to the enormous size of the population, over 68% of which live in rural areas (Government of India, 2011). One simplified answer is that the fit, scale, and sustainability of the solutions are insufficient to meet the needs of the millions of people lacking access to clean water.

Fit refers to the price and appropriateness of technology. Some water cleaning products are too expensive for the average Indian family to purchase. For example, a wall-mounted filtration unit could easily cost the equivalent of one month's salary for a family living on between $3-4 per day. Despite the fact that families at this income level are living above the extreme poverty line, defined as $2 or less per day (World Bank, 2010), this water-cleaning product is financially out of reach.

Even if sold at an affordable price, the technology for some water-cleaning products does not reflect the daily realities of those living at or near the poverty line. The lack of access to reliable electricity in the home, limited income to afford extra cooking fuel needed to boil water, unintuitive products or those that need instruction or training are just a few examples of why products can fail. The requirements needed to make them work effectively do not align with the challenges faced by the people who could most benefit.

Figure.1 Water collecting in a steel urn: unreliable water service is common in communities where the CleanCube project is based.

Perhaps the most significant reason why the problem of access to clean water persists in India despite the many different water cleaning products available is that the solutions offered are not designed to scale up to reach a large, diverse, primarily rural population. As such, they are not inherently sustainable. Products that are too expensive cannot be scaled to meet the vast needs of Indian consumers, nor can products using technology or methods that do not reflect the realities of those living at the base of the economic pyramid. This may seem intuitive to most people; however, products designed specifically to meet challenges head-on and to reach scale like those donated through large governmental programs, charities, or NGOs also often fail to deliver sustainable solutions.

Intentionally designed products like the LifeStraw, UV filtration units, and other products created for use in the Global South have often relied on campaigns to reach as many people as possible. There is no doubt that such initiatives help to bring clean water to people who need it. However, when it comes to long-term adoption and the overall improvement of chronic water issues, these solutions often fall short. For example, if a product that is dropped into a community stops working and requires maintenance or replacement, the lack of infrastructure around the product will make it obsolete. In these situations, there is no local knowledge or financial mechanism to support the product's long-term use, and, thus, its potential long-term, sustainable benefit.

1.2 Scale and sustainability

A solution that depends on outside funding and expertise does not result in long-term benefit, because once the funding is gone or the outside expert knowledge leaves, local communities are left with no resources to keep it going. Often, a product intended for humanitarian purposes is manufactured cheaply in China in order to keeps costs low. This approach does not allow for economic spin off to occur in the area where the product is being distributed and used. Without a sustainable model for production, distribution, maintenance, and local economic impact, the solution that has been introduced has little chance of making meaningful inroads to eradicating the problem.

One-size-fits-all solutions aiming to reach as many people as possible often fail because the solution tries to fit everyone but in so doing fits no one. The cultural sustainability of a product cannot be underestimated. A product that ignores local traditions and attitudes or fails to test its effectiveness in the field when used by local people is set up for failure. A product that creates no local economic impact misses a tremendous opportunity to develop the capacity that can help a solution thrive over the long term. A solution that is environmentally unsound and that engages in socially unsustainable business practices, like ignoring labour practices lurking behind low cost manufacturing, is exploiting one

group of people in order to help another. Models that fail to consider the entire ecosystem around a proposed solution can inadvertently do more harm than good.

So what is the answer? The answer is that a sustainable solution, one that closely considers the environmental, cultural, social, and financial impacts, has the best chance for making measurable change over the long term. Products designed hand in hand with those they are intended to benefit and which reflect unique and very specific strengths and challenges at a local level have a better chance for broader adoption, impact and benefit.

This is the impetus behind the CleanCube project: to develop a solution that brings clean water to communities that need it. The design parameters for the project and for the resulting water-cleaning product are its affordability and the use of an appropriate technology that is intuitive. However, the solution is not just the object itself, it is the process by which it is derived and the system in which the product exists. Using the participatory design process and developing a business model that directly engages women in the economic life of the CleanCube product is key. Creating an ecosystem around the solution ensures it is self-sustaining and able to be replicated and scaled. The end goal is to maximize its reach and impact over the long term.

2. Project background

In 2014, the CleanCube project received research funding from Grand Challenges Canada's Stars in Global Health program. Grand Challenges Canada is dedicated to supporting Bold Ideas with Big Impact® in global health. Funded by the Government of Canada, Grand Challenges Canada focuses on funding social enterprises that offer innovative solutions to some of the most challenging global issues. This proof of concept funding makes field-based testing of CleanCube possible.

The goal of the CleanCube project is to develop a product that provides clean water and that can be manufactured locally and made widely accessible through broad market distribution and affordable pricing. Inspired by highly successful Indian companies like Lijjat Papad and Amul, which were built upon decentralized, cooperative business models, this project is adapting the most innovative and relevant aspects of these approaches to the CleanCube model. Based on the model of small batch production located within pilot communities, the goal is to employ women to complete tasks that can be done close by or within their homes and that do not interfere with their household responsibilities. An objective of CleanCube is to offer women a direct means to generate income for their families; thereby, also increasingly the possibility to raise their status in the home and broader community.

2.1 Community-based research and key insights

Working in collaboration with an India-based co-investigator, a pilot community for the CleanCube Project was identified and work began to establish the connections needed to make the project thrive here. The pilot community is located in South Goa. It is a residential slum built up around an industrial area attached to a large agriculture chemical plant. The majority of the residents living there are migrants from farms and villages of the neighboring state of Karnataka who relocated in search for work. Most households have one or more family members who work in some capacity for the main factory or the surrounding auxiliary businesses and services.

The project commenced by building relationships with local community leaders. Working in conjunction with a doctor, free weekly health clinics focused on women and children help to build trust and rapport with women in the community. Making the connection between water, health, sanitation and hygiene has been a critical cornerstone of the CleanCube project and the community's buy-in and participation in the project.

Figure.2 Waste, water, and health are inextricably linked in the CleanCube pilot community.

An initial survey of 33 households provided significant data about water usage, water cleaning and storage practices, health and hygiene, and economic livelihood. The focus of the survey was women, and the objective was to learn about their relationship with water and the intersection with the health and wealth in their homes. In this community, household taps deliver water but for only part of the day. All residents reported that there are several hours in a 24-hour period or sometimes days in a row in which no running water is available and, thus, reliance on stored water is crucial. Households use large plastic barrels to store water. The collection, storage, and usage of the water in the household are consistently the responsibility of the women, often falling on the shoulders of the youngest daughter or daughter-in-law.

Figure.3 A young woman washes clothing using stored water.

One of the key insights gleaned from these surveys was the cleaning methods used and the correlation with household illness. Only a few women reported boiling their drinking water or using a commercial filter device. However, those who did use these methods reported fewer incidents of illness in the household. In comparison, the majority of those surveyed reported higher occurrences of cold and flu-like symptoms, skin infections, and stomach pains among adults, but especially in children. These symptoms correlate with those caused by ingesting water containing bacteria like e. coli.

Over 90% of women reported having no indoor bathrooms, explaining that their toileting facilities are located in an open field located between the outskirts of the slum residences and the nearby highway. All respondents reported dumping their household garbage in an open area also located in the vicinity of the open toilets. Other community members who were not surveyed said that these practices were particularly problematic in the rainy season when runoff carrying garbage plugs the ditches located within the community and brings trash, as well as human and animal waste in and around homes.

Another key observation is the common practice of using a piece of scrap cloth as a filtering device. More than half of the women reported using this as a means to “clean the water”, or removing visible sediment from the water, coming through the tap. The surveys and interviews also illuminated some of the economic goals and challenges the households face. Most of the women surveyed expressed their desire to generate more income for their family. The primary purpose of any additional income, as most women explained, would be to finance their children’s education and to improve the physical structure of their homes, including adding toileting facilities. Almost all respondents who indicated their interest in earning additional income reported that they had two to four hours free in the middle of the day for income generation activities, a fact that is very relevant to the business model that forms the basis for the CleanCube project.

Figure.4 A local household solution to filtering sediment from water is placing a scrap of cloth over the tap.

2.2 Prototyping, testing, and co-designing

Using these key survey findings and field observations, the next stage of the CleanCube project is the continued development and testing of prototypes and models. CleanCube is a working name, which was derived from the early prototypes that were cube shaped and made from both clay and dissolvable materials. Based on recent work with women in the pilot community, another set of viable prototypes has been developed and is being tested. One of the prototypes builds directly from the intuitive practices used by local women. The common thread among the prototypes in development is that they rely on a low-tech, physical process of removing bacteria from the water. They are small in size, environmentally sustainable, highly intuitive for a user, and they hold up to daily use.

Various materials and production methods are being researched and evaluated on their effectiveness, as well as their ability to be produced locally and at a low cost. In collaboration with a local university, testing of water samples and of prototypes is being conducted in a laboratory setting. The results of these tests inform the continued fieldwork in the pilot community.

A key piece of the project is utilizing the participatory design process to ensure that the resulting solution is a true reflection of the community. Interviews, workshops, and other activities pull additional insights that shape the evolution of prototypes and distribution models. It is critical to understand the use, adoption, and effectiveness of promising water cleaning prototypes over the short and long term. This understanding comes from working with a diverse cross section of the community. Factors critical to a resulting product's success are ensuring it is easy to use, affordable, durable, and culturally relevant from the local perspective.

3. Proposed model

For CleanCube to be effective over the long term, it is imperative to have a model for production and distribution that is self-sustaining. Building such a model is a powerful opportunity to create economic and empowerment opportunities for women. One way to achieve this is a decentralized production and distribution model in which a maximized number of women have the opportunity to participate and benefit.

India has several examples of decentralized, cooperatives business structures that have a strong social mission and have been highly successful financially. These examples offer many lessons to others looking to glean from and replicate aspects of these organizations in their own social ventures. Perhaps the most impressive example and one that serves as a guiding force for the CleanCube project is Shri Mahila Griha Udyog Lijjat Papad.

3.1 Powerful papad example

Lijjat Papad is a cooperative of women producing primarily papad, a circular snack that is a staple in many Indian households, as well as other food products and detergent. Started in 1959 with the goal to create economic opportunities for women at home, what began with seven women now boosts over 43,000 female members. Lijjat's guiding philosophy is based on the ideals of Mahatma Gandhi: self-reliance, cooperation, mutual trust and respect. In order to become a member of the cooperative each woman must start as a "roller", a person responsible for rolling papad (Bhatnagar, 2002).

Each morning, members arrive at the local Lijjat branch, which is located within a few kilometers of their houses, to pick up their allotment of dough for the day. The women return to their homes where they each roll out a prescribed number of papads using their Lijjat-supplied rolling pin and drying basket. Working around their daily household responsibilities, women fit in the time to roll and dry the papads. At the end of the day, the women return the finished papads and receive payment for their work. At the branches, the papads are inspected, packaged and made ready to be sold locally and picked up by distributors to be transported to retail outlets.

Lijjat is ISO 9001 certified, and in 2013 it reported sales of approximately $100 million USD. Over 4% of sales come from worldwide exports (WIPO, 2014). In addition to the income members earn while working at home, Lijjat shares dividends with all members equally and also offers other support. Lijjat established a charitable foundation to provide education scholarships to members' children, as well as literacy training, small loans, and financial support for its members in times of need.

Lijjat not only offers lessons on producing a popular, quality product that is efficiently made and distributed but also demonstrates how a cooperative model created by and for women can work and result in positive societal change. Members can double their household income, which often goes towards children's education, medical care, and home improvements. Overall, these activities give women a stronger voice within their households and within the broader community, the impacts of which can be far-reaching and profound.

Figure.5 A member of Lijjat Papad demonstrates how to roll papad.

3.2 Local branches - pieces of a larger whole

The goal for CleanCube is to develop the local infrastructure to create small manufacturing hubs or branches to produce and distribute CleanCube units. Working within the home or in very close proximity, as in the Lijjat model, women can work around their daily schedules to take on this flexible work. Their earnings can significantly contribute to the household. This model offers women both economic and potential social empowerment opportunities without outwardly disrupting the cultural dynamics of the home and community.

Local branches in the community will become the centers for training, product inspection, quality control, and packaging and preparation for distribution. The CleanCube products will be sold through local distributors at stores and by vendors in the vicinity. At the branch level, transparent accounting will be maintained. As part of this model, women will be paid daily based on what they have produced during their working period.

These local branches will also become a hub for health and sanitation education for workers, as well as for other community members. Based on small self-sustaining ecosystems, the CleanCube model can be scaled up by replicating branches in other communities. Instead of a large centralized factory requiring significant overhead and workers to travel away from home for standard shifts, this decentralized approach keeps

the solution local, flexible, and reflective of the needs and realities of the women it is designed to benefit.

By the end of the grant period, the objective for the CleanCube project is to determine the feasibility of this water-cleaning solution as a sustainable and scalable approach. After the successful completion of this stage, CleanCube will have the opportunity to apply for additional funding, which will support product development and full project implementation. It is the full intention of the project to become a viable product offering in the marketplace that makes profits for all those involved, including every woman working at the community branch level.

3.3 Small, beautiful, scalable, and profitable

This small ecosystem approach pulls inspiration from the work of E. F. Schumacher in his book *Small is Beautiful* and from the microfinance movement championed by the Nobel Peace Prize Laureate, Muhammad Yunus. Schumacher's call for economic systems that are smaller and more local (Schumacher, 1973), and Yunus's work to put small amounts of capital into the hands of the world's poorest challenges the conventional notions of efficiency and effectiveness (Yunus, 1999).

Building solutions and economic mechanisms that are at a human scale offer an alternative to the current globalization-driven capitalist model – where bigger stores and more cost efficient supply chains means bigger profits and market share. However, in the business of bringing clean water to those with the least amount of pocket change, local, self-sustainable, and scalable solutions are the answer. There is a need for a different model - for businesses, NGOs, and charities - one that is financially viable and efficient but where success is also defined by local impact and long-term change.

4. Conclusion

The CleanCube project aims to encompass the broadest definition of sustainability. It does not just focus on an environmentally sustainable way to clean water but creates a means for people to continue to gain access to the solution over time. Establishing a cooperative business model helps to develop financial sustainability through community ownership and non-reliance on outside funding and expertise to continue. This model builds a structure for ongoing distribution and accessible pricing. The focus on women's empowerment while including input and buy-in from both male and female members of the community are critical pieces to the social sustainability of the model. The participatory design process gleans local knowledge and is shaped by the daily practices of women in the community to

ensure that the solution is culturally sustainable. It is this well-rounded, holistic approach to sustainability that is lacking in most solutions designed for the Global South.

No one-size-fits-all solutions exist. The pull to respond to global issues with a broad brush is reactionary, a waste of resources, and can do more harm in local communities than good, no matter how well intentioned the action. Models that build upon insights from the community and seek to empower women as income generators and decision makers are better alternatives. They can be adapted and replicated and can potentially reach millions of people.

One goal of the CleanCube project is to demonstrate that this model is an effective solution not just to water issues but also to other difficult problems. Design practitioners taking on other complex global challenges have the opportunity to apply a similar holistic approach to co-designing sustainable solutions. Working in local communities sharing and gleaning knowledge, building capacity, and planting the seeds for an effective, scalable product requires an investment of time and resources but yields the most potential for real, sustainable solutions. The development of an effective product or technology that will improve a chronic problem is essential. Looking beyond the product itself to design the entire ecosystem around the solution is what creates the potential for momentous change. This type of approach makes way for powerful design interventions that can overcome barriers of distribution, financing, and cultural adoption to reach scale in other communities and around other challenges across India and in other parts of the world.

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