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### LifeStraw: A Sustainable Approach to Water Reuse in Developing Nations

Undoubtedly, water is essential to our survival, a fact that some in developed nations such as the United States of America may take for granted due to easy access or the illusion of abundance. For example, although water covers 70% of the earth's surface, only about 1% of it is drinkable. And while developed nations generally have highly established water distribution infrastructures, twenty six countries worldwide are currently listed as "water-stressed", meaning that they do not have enough water to maintain economic growth (10). And unfortunately, approximately 1.1 billion people do not have access to clean water worldwide; "water-borne pathogens are a huge problem for the environment and for human health" (2).

The world wide water situation is anything but sustainable at this point in time as our remaining supply of potable water diminishes due to pollution, over use, and general waste. Drastic plans have been put into effect in an attempt to combat this potential crisis, such as China's project to build the world's largest dam on the Yangtze, a project that will destroy the surrounding ecosystem while also displacing millions of locals (10). Such a project is only a desperate response to an impending calamity. According to the Natural Step Framework, in a sustainable society, "people are not subject to conditions that systematically undermine their capacity to meet their needs" (11). While developed nations have to deal with water waste issues, people living in third world countries must actively seek out water sources which are unfortunately contaminated with bacteria, parasites, and viruses. Following the Natural Step mindset, a sustainable system has to be



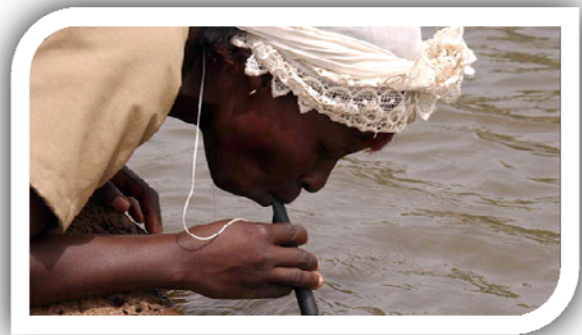
**The LifeStraw instantly turns unclean water into safe drinking water.**

created in order to deliver clean water to those who need it.

Vastergaard Frandsen, a company with hopes to meet the UN's Millennium Development Goals, created the LifeStraw system in order to provide clean water in an easy and sustainable way (9). The LifeStraw is a 25 cm long plastic pipe that acts as a water purification tool. It is for personal use and can last approximately six to twelve months. The company asserts that it has a life time of 700 liters (7). The device has been heralded as one that could become one of the greatest life-savers in history. Designed to address the needs of the more than 1.1 billion people who lack access to safe and clean drinking water, it is user friendly and requires no electricity, batteries or replacement parts (5). LifeStraw requires no more than the user's ability to suck up water and it is priced at a little more than \$3.00 per unit.

The straw uses seven types of filters, including "mesh, active carbon and iodine" (4). When the user sucks up the water, it first goes through a fine textile mesh that has openings of 100 microns across. This prefilter removes the biggest parasites from the equation. Next the water goes through a similar filter this time with a 15 micron mesh which removes smaller parasites, bacteria clusters and particles (8). After that, the water goes through a chamber of iodine impregnated beads that kill off a majority of bacteria, viruses and parasites. This is followed by an open chamber that allows for the iodine to kill even more bacteria and parasites. The last compartment consists of active carbon which removes the bad taste of iodine while also eliminating persistent parasites (8). Independent research labs have evaluated the LifeStraw's efficacy and have determined that the sucked water actually contains fewer bacteria than tap water (7).

Contrary to its powerful filtering system which outputs clean water in a sustainable no-energy use fashion, the remaining portions of the LifeStraw's lifecycle do not follow a green design framework. For one, the shell of the device is made of polystyrene which is environmentally



**The LifeStraw can be used to drink directly from any freshwater source.**

unfriendly. And although the device can last a relatively long time (six to twelve months for one person) it is inherently disposable. The product was not designed to be recyclable or biodegradable although this could be due to the profile of the target users who are generally poor and waste very little as it stands. Yet, regardless of these negative points, the product uses no energy once created (outside of the user's sucking power). And most importantly, its ability to turn unhealthy, unusable water into potable water warrants a great deal of points towards its sustainability.

Furthermore, the LifeStraw's benefits can be elucidated further by comparing its efficacy and feasibility to existing systems. One such system that is widely used in developed nations is having a central water distribution plant that filters and delivers clean water through pipes directly into people's homes. Such a system works very well in developed nations and is generally expected to deliver clean water reliably and consistently. However, the story is very different in developing nations. In Khartoum, the capital of Sudan, a distribution system is in place but citizens neither expect nor get clean water on a consistent basis. In fact, when water does come, tinted in color and obviously dirty, users generally begin to hoard it in large barrels before the water cuts off again. This response can be attributed to major shortcomings of these third world centralized distribution systems.

A phenomenal amount of money, expertise, and manpower goes into running a successful water supplier. For developed nations, water is generally cleaned at a centrally located water treatment center using many methods of purification such as UV treatment and carbon filtration (14). The water is then distributed to households via an intricate system of underground pipes. These pipes must be continuously maintained in order to ensure that the 'faucet' water is as clean as the initial output



**Water treatment facilities require massive infrastructural changes to the environment.**

of the treatment plant. Bacteria levels, water disinfectant concentration, piping status, and flow must be consistently checked to guarantee the public's health. Khartoum, and other developing cities, do not possess the same level of expert personnel, financial budget, or commitment and therefore struggle to provide citizens with clean water on a reliable basis (15). In greater contrast to this situation, there are places that are completely separated from water distribution plants and the people living in these areas must actively seek out water in order to survive. In light of the challenges that face current third world country water distribution plants, it would not be feasible to lay down entirely new networks in order to reach these people. Such a plan would be detrimental not only to the surrounding ecosystem but would also require a change of lifestyle for these 'separated' people. They would have to outfit their homes with faucets and pipes while also getting used to a nearby water distribution plant. In any manner, a water distribution plant similar to the norm in established communities of the developed nations would be environmentally as well as culturally unfriendly. In contrast to this, the LifeStraw provides these people who are in need of clean water, with a medium to clean their existing water supply.

The problems of water distribution plants in third world countries has been recognized by many and has lead inventors to develop other means of delivering potable water to these areas. Dean Kamen is one of these inventors. He created a vapor compression distiller that he claims will take any liquid (poison, ocean water, sewage, etc) and turn it into clean potable water (12). The device, named the Slingshot, is made up of a distiller and condenser and is meant to be very energy efficient. The Slingshot can create about 10 gallons of pure water while running on 500 watts of energy, which can come from Kamen's cow dung powered electric generator(13). The device is still being introduced into the market, and Kamen is negotiating deals with third world leaders in order to implement the Slingshot



Dean Kamen with his water distiller device.

in suitable places. Compared to the LifeStraw, the Slingshot performs a very different role. For one, it is not meant for personal use. Instead, the idea would be to install it in central locations (which would obviate the need for a massive infrastructural change such as a water distribution system). Also, the device purifies water by turning it into vapor and then collecting and condensing the vapor into clean water, therefore, no filters or membranes are used. Additionally, each unit can cost up to \$1,000 and requires energy to operate making it difficult for rural people to benefit from its use. So while the Slingshot may output cleaner water than the LifeStraw, its cost, bulk, and post-production energy requirements make it less sustainable, especially in impoverished areas. In contrast, the LifeStraw is relatively cheap and portable, benefitting even the most nomadic of people.

Although it is not recyclable, the LifeStraw is much more sustainable as a water purification device because, compared with existing technologies, it provides high standard potable water for very little change in the infrastructure and culture of its users. However, because it uses filters, it is not 100% effective. For example, it will not make salt water drinkable nor can it filter out heavy metals. And although its focus is on removing bacteria and parasites from dirty water, it cannot filter out *Giardia lamblia*, the cause of 'beaver fever', because the Protozoan is smaller than 5 microns and is resistant to iodine (8). The company is currently working on making a better LifeStraw that will remove *Giardia* by making a better filtration system. The cost is also relative; \$3.00 may be very little to those in developed nations but it is very expensive for those living in third world countries because they earn less than one dollar per day, money which goes towards feeding their families (9). The situation is desperate but initiative can be taken in at least two directions. At one level, the company can work on creating a cheaper LifeStraw by using less expensive materials (which can also be biodegradable, such as bamboo). If, however, changing LifeStraw's design



**Without proper education, LifeStraw users could become susceptible to diseases such as bilharzia due to parastic infection from treading infested waters.**

compromises its efficacy, massive funds can be started in which people can be asked to donate \$3.00 in order to provide one person with clean water for six months to a year. Because the price is affordable to those in developed nations and has such a high positive impact for very little input, such a fund could possibly work. It would also increase awareness about the water problem in developing countries and potentially lead to more sustainable living for participants who would not take water for granted. The biggest problem with LifeStraw is that it only *cleans* water, which means that people must still actively seek out water sources in order to survive. But at least now the water they gather will be less deleterious. To solve this problem in the most sustainable way, LifeStraw distributions can be coupled with 'water capturing barrels' which would gather murky rainwater. This would allow people to become more productive because they would spend less time actively trying to survive. Also, the clean water provided by the LifeStraw would mean fewer devastating illnesses and deaths for those who previously had no access to potable water.

In review, the LifeStraw can provide people in developing nations with access to clean water in a very sustainable way. It is simply worn around the neck and is used like a regular straw, while also filtering out 99.9% of bacteria and 98.7% of viruses (1). It provides the neediest of the world's population with a basic yet essential need that is free of the risk of typhoid, cholera, dysentery and diarrhea (2). These are diseases that kill at least 2 million people every year in the developing nations (4). And although the product is not perfect, it would perform much better than a water distribution center or Dean Kamen's Slingshot in the most needy of places while also having less of an environmental impact. Most importantly, it follows the fourth step of the Natural Step Framework which is to provide people with a sustainable way to meet their most basic need.



**If used correctly, the LifeStraw can provide users with access to clean water so that they may spend more time working or playing.**



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Notes:

- LifeStraw personal® is referred to simply as 'LifeStraw' in this paper.

- Information regarding the initial energy input into developing the LifeStraw and Kamen's Slingshot was not found.