

## INCLUSIVE INNOVATIONS

# Inclusive Business Models for Wastewater Treatment

*Enterprises have developed integrated, affordable wastewater treatment solutions for industries and households to encourage reuse or safe disposal*

### HIGHLIGHTS

- Wastewater treatment enterprises treat water before disposal or recycle the water so that it can be reused.
- Enterprises provide household wastewater treatment systems that are modular, have low operating costs in terms of electricity and maintenance, have silent operation and less odor and offer quick returns on investment.
- Enterprises focusing on industrial wastewater treatment solutions offer efficiency and cost effectiveness. They are quickly commissioned, fully automatic, have remote monitoring, require minimal hazardous chemicals, and treat water for reuse.



### Summary

Wastewater sources include domestic wastewater—pertaining to liquid outflow from toilets, bathrooms, basins, laundry, kitchen sinks and floor washing, and industrial wastewater—effluent water that is discharged during manufacturing processes in factories or by-products from chemical reactions. There are significant operational and financial challenges associated with wastewater treatment in marginalized residential communities, where domestic wastewater does not get treated at source, but instead is discharged to local municipal facilities or directly into water bodies. Similarly, industrial wastewater is heavily contaminated and leads to pollution and diseases, if disposed without treatment. It may also contain metals that have high market value and could potentially be recovered.

Social enterprises have introduced unique technologies and integrated solutions to treat such wastewater either for safe disposal or for reuse. These solutions aim to be efficient, affordable and convenient. There are two major types of wastewater treatment plants—household (residential) systems and industrial systems.



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*This series on Inclusive Innovations explores business models that improve the lives of those living in extreme poverty. Editors are Elaine Tinsley and Natalia Agapitova. Researched and developed by Intellectap.*

## Development Challenge

In a developing urban society, wastewater generation usually averages 30-70 cubic meters per person per year. Thus, a city of one million people can generate wastewater that would be sufficient to irrigate approximately 1500-3500 hectares<sup>1</sup>. Unfortunately, in developing countries, approximately 90 percent of wastewater is untreated when discharged<sup>2</sup>. Water pollution causes illness and accounts for 50 million deaths per year worldwide, especially in Africa and Asia<sup>3</sup>.

Wastewater management is increasingly becoming a priority issue in developing countries; accelerating urbanization exacerbates the situation resulting from inadequate systems, technology and infrastructure. In most developing countries, wastewater treatment is the responsibility of the local Government. Municipal treatment of household sewage involving large collection networks and treatment plants incur enormous costs and considerable time for construction. These centralized treatment plants are also often economically unviable as they require investments in collection and conveyance of wastewater via piped networks. Due to the dependence on “end-of-pipe” wastewater treatment instead of on-site residential wastewater treatment technologies, the reuse rate is less. This is because end-of-pipe treatment is generally operated at locations away from the source of municipal supply, and transporting recycled water may be costly and inefficient.

**Unsafe water is the primary cause of hospitalization, disease and death in emerging countries**

Similarly, there are challenges in treating industrial waste water. Manufacturing units generate large volumes of effluents, which include toxic and hazardous components such as feedstock materials, by-products and product residues, washing/cleaning agents, solvents, and other products like plasticizers. When left untreated and unattended, such industrial effluents pose a huge threat to the environment, including soil health deterioration, water table contamination, and other potential health hazards. Wastewater treatment allows human and industrial effluents to be disposed of without danger to health or damage to the environment. Treated wastewater can alleviate water supply challenges, and be used for non-potable purposes such as agricultural and landscape irrigation, industrial processes, toilet flushing, and recharging groundwater basins. Water reuse allows communities to become less dependent on groundwater and surface water sources, and can decrease the diversion of water from sensitive ecosystems.

## Business Model

Wastewater treatment is deployed by a broad range of industries and government bodies such as municipalities for safe disposal or recycling of water. Some industries that use wastewater treatment systems include pulp and paper industry, food and beverage industry, marine industry, poultry and aquaculture, healthcare, and chemicals. Municipal wastewater treatment and the food and beverage processing industry form the major share of the market. Water scarcity, energy savings, and increasingly complex industrial wastewater treatment demands are pushing companies to implement new techniques to optimize environmental and economic performance.

For many small and medium enterprises and residential blocks, conventional wastewater treatment systems are very technically sophisticated and expensive. The conventional systems often rely on high energy inputs for operations and require extensive maintenance services. In order to address this challenge, there is a growing market for decentralized wastewater management systems (systems that treat and disperse wastewater from individual homes or a cluster of homes at or near the source of the wastewater discharge) for residential households too. These systems allow wastewater to be recycled and reused for daily water needs such as



<sup>1</sup> Wastewater Treatment and Reuse: Sustainability Options; Consilience: The Journal of Sustainable Development

<sup>2</sup> <http://www.biasharaleo.co.ke/index.php/en/2014-10-19-18-25-47/main-story/item/202-agua-kenya-banks-on-plants-to-turn-waste-water-into-treasure>

<sup>3</sup> <https://www.changemakers.com/discussions/entries/fungi-based-waste-water-treatment>

washing, bathing and cooking. Such onsite and decentralized wastewater treatment systems can also support water resource management goals in many arid areas of the country. Their use complements existing infrastructure in situations where centralized sewerage is impractical, unaffordable, or water reuse is desired. They are compatible with municipal wastewater treatment infrastructure and can provide pretreatment and sewer mining support, in addition to serving as an alternative where centralized plants have reached or exceeded capacity.

**Figure 1. Household and industrial wastewater treatment**

<b>Why?</b> <b>Development Challenges</b>	<ul style="list-style-type: none"> <li>Household waste water (i.e. sewage) from toilet, kitchen, laundry etc. contains harmful bacteria / viruses and chemicals that contaminate land and water bodies and may lead to outbreak of water-borne diseases</li> <li>Municipal centralized collection and treatment of domestic waste water can be cost-prohibitive and decreases reusability of water</li> </ul>	
	<ul style="list-style-type: none"> <li>Industrial waste water (i.e. effluent) contains heavy metals which need to be extracted, not only because they are toxic and hazardous, but also because they may be valuable</li> <li>Small commercial setups, required to comply with environmental regulations find it difficult and expensive to treat wastewater</li> </ul>	
<b>What?</b> <b>Operational phases</b>	<b>Household wastewater treatment</b> 	<b>Industrial wastewater treatment</b> 
<b>How?</b> <b>Key Activities</b>	<ul style="list-style-type: none"> <li>Social enterprises offer ready-to-use sewage treatment solutions to societies / apartments</li> <li>They deploy innovative technologies to make the product sustainable, cost-effective and energy-efficient</li> <li>The treated water is used for non-potable applications like toilet flushing, gardening, construction and filling of water ponds</li> </ul>	<ul style="list-style-type: none"> <li>Enterprises provide end-to-end solution for extraction of hazardous / valuable components from waste water</li> <li>Generally, the technology is such that the plants can be installed with minimal on-site fabrication, space requirement and manual operation</li> <li>Advanced treatment plants are automated and are energy-efficient, making them cost-effective</li> </ul>
<b>Examples</b>	<ul style="list-style-type: none"> <li>Wetland Works!, Ecosoftt, Grey Water (Jaldhara), Greenenvironment Innovation and Marketing, AcuaCare,</li> </ul>	<ul style="list-style-type: none"> <li>Agua Inc, Bridgedots, India Green Services, SKS Infrastructure, Vision Earth Care, Saha Global</li> </ul>

#### **Household wastewater treatment**

Many social enterprises have developed solutions that not only address domestic wastewater disposal, but also facilitate recycling of the waste water such that it can be used for cleaning, irrigation, flushing and other non-drinking purposes. These enterprises treat both, greywater (wastewater from non-toilet plumbing fixtures such as showers, basins and taps) and blackwater (water that has been mixed with waste from the toilet, kitchen and dishwashers). The household systems generally have a capacity that ranges from 1.5 m<sup>3</sup> to 150 m<sup>3</sup> and serve 1-20 households or small enterprises<sup>4</sup>.

Some solutions also use unique biological treatment methods to treat water from commercial buildings. Vision Earth Care, a India-based startup, uses a unique soil biotechnology (SBT) process to provide water treatment and reuse for hotels, resorts, hospitals, and railways. Its treatment plants incur operational and maintenance costs that are 60 percent lower than a conventional sewage treatment plant. It uses a novel high-efficiency natural oxidation process that replaces the use of heavy blowers for

**Ecosoftt also provides water education to children, rainwater harvesting systems and systems for wastewater recovery and groundwater recharge**

<sup>4</sup> <http://www.borda-net.org/basic-needs-services/decentralized-wastewater-treatment.html>

oxidation in conventional technologies. The recycled water can be used for water-demanding activities such as toilet-flushing, gardening, irrigation, construction work, and car washing. Because of its high oxygen content, it can also be used in fish farms.

Generally, most traditional water treatment solutions have been bulky and require space. In order to address this issue, some enterprises have developed lightweight and modular solutions. For example, Grey Water (Jaldhara Technologies Pvt. Ltd.) manufactures decentralized and fully automatic sewage treatment systems which purify and recirculate water for cleaning homes, heating/cooling, and flushing. Their systems require minimum installation work and are plug-and-play solutions. Additionally, they have fewer moving parts than conventional systems, thus creating no noise.

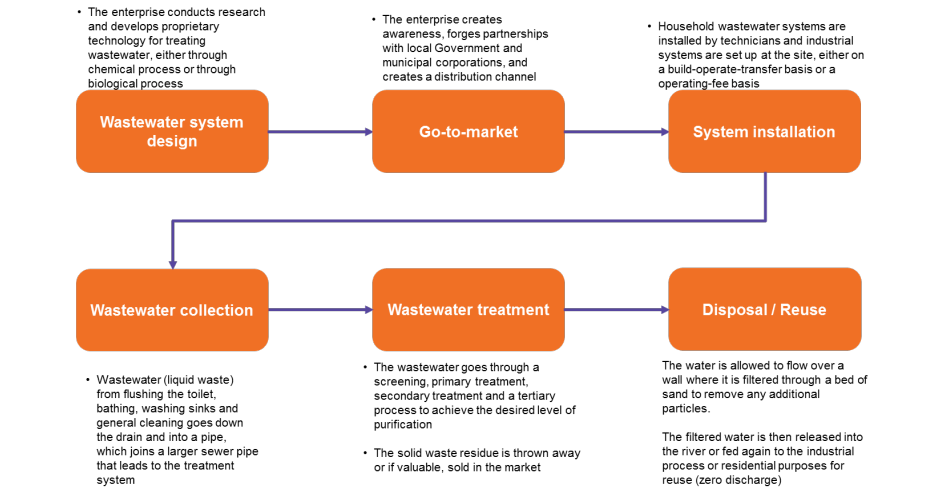
**Industrial wastewater treatment**

Social enterprises help small-scale industries meet their environment compliance requirements by providing technologies and consultancy services to minimize sludge formation and meet zero liquid discharge goals. Sludge obtained after wastewater treatment has high water content. Since the cost of sludge disposal is determined by weight, and water is heavy, dewatering sludge is crucial for industries. Some enterprises have developed unique technologies to increase the efficiency of sludge dewatering. Bridgedots, an Indian waste management enterprise, has developed a water repellent (hydrophobic) coating for polypropylene and cotton bags used in sludge dewatering. The water repellent coating makes the dewatering process efficient.

Bridgedots has a water repellent product for increasing the efficiency of sludge dewatering, making the disposal of industrial wastewater cost-effective

Since industries produce different effluents, some enterprises focus on a particular industry for wastewater treatment. For example, Synergy Waste Management, an enterprise in India, provides treatment of effluent water generated during treatment of bio-medical waste and reuse of treated water for plantation and cleaning purposes. It provides collection and transportation facilities too. Synergy provides centralized treatment facilities to municipal corporations and decentralized treatment solutions to medical institutes, hospitals, nursing homes, laboratories, blood banks, and diagnostic centers.

Figure 2. Wastewater treatment, design to collection to disposal/reuse



### Cost Factors

The capital costs of wastewater treatment plants include civil construction, equipment supply and installation, auxiliary buildings, and contractors' overheads. Running costs of wastewater treatment plants mainly include wastewater discharge fee, electricity cost, chemical cost, staff cost, maintenance and replacement cost, sludge disposal, administration cost. Waste water plants incur high electricity costs<sup>5</sup>. The proportion of these components in total cost varies in different plants. Generally, the monthly cost per m<sup>3</sup> of water treated is USD 0.11<sup>6</sup>. In India, if an industry has to manage a sewage plant which cleans 60 million liters of water daily, the annual cost is around USD 0.55 million<sup>7</sup>.

**Table 1. Costs and components**

Type	Cost components
Capital costs <sup>8</sup>	Civil construction: 25-40 percent Equipment supply and installation: 20-30 percent Auxiliary buildings: 10-20 percent Contractor's overhead: 10-20 percent
Operating costs <sup>9</sup>	Electricity fee: 27 percent Water discharge fee: 18 percent Staff cost: 18 percent Sludge transport and disposal: 13 percent Maintenance and replacement cost: 10 percent Administration and marketing cost: 9 percent Chemical fee: 6 percent

The most important factors impacting the costs of a household water treatment plant are<sup>10</sup>:

1. Consumer awareness: Lack of consumer awareness may lead to high marketing costs
2. Market size: Willingness or ability to invest in a long-term wastewater management solution is an important cost consideration for enterprises while designing their systems
3. Locally sourced materials: Some filters and membranes may be expensive to obtain and manufacturing cost may be higher due to import of such material

The most important factors impacting the costs of an industrial water treatment plant are<sup>11</sup>:

1. Economies of scale: The cost per liter of wastewater processed generally goes down as the capacity goes up.
2. Density of Development: Densely developed areas are the most cost effective as collection costs are minimized due to shorter sewer length.
3. Land costs: Suitable land is scarce and expensive. If a treatment plant occupies less space, the costs could be considerably lower.

### Revenue Streams

The major revenue streams for household wastewater treatment systems are from sale of the product, annual maintenance fee and installation charges. For industrial wastewater systems, major revenue streams include price of system setup, consulting fees and operating fees. Industrial wastewater treatment enterprises generally either just design and build the systems for municipalities and large processing plants, or manage the

<sup>5</sup> <http://www.costwater.com/runningcostwastewater.htm>

<sup>6</sup> Ibid

<sup>7</sup> <http://www.businesstoday.in/magazine/features/water-treatment-business-in-india/story/200284.html>

<sup>8</sup> Primary interviews

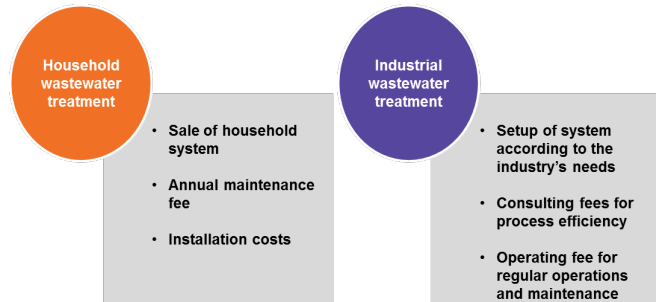
<sup>9</sup> <http://www.costwater.com/runningcostwastewater.htm>

<sup>10</sup> Primary interviews

<sup>11</sup> [http://www.capecodcommission.org/resources/RWMP/RWMP\\_costs\\_comparative.pdf](http://www.capecodcommission.org/resources/RWMP/RWMP_costs_comparative.pdf)

complete end-to-end installation and operations. The revenues for enterprises that adopt a build-operate-transfer (BOT) approach come largely from the initial setup fees and these revenues are not recurring from one plant. Most industrial treatment plants are presently BOT-based and prefer to take up projects initiated by the Government or funded by multilateral agencies. In India, a majority of the water-related projects are being executed for government bodies with financial support from the Jawaharlal Nehru National Urban Renewal Mission (JNNURM)<sup>12</sup>, Japan International Cooperation Agency, Asian Development Bank and the World Bank. Hence revenue and cash flows have been reasonable. Revenues from the private sector (large processing industries) are still limited.

**Figure 3. Household versus industrial wastewater treatment**



In India, a typical household water treatment plant is priced at about USD 500 (INR 30,000)<sup>13</sup>. The pricing of household wastewater systems is still quite high and hence, unaffordable for individual households. Most decentralized systems are currently community-based and serve several households or are installed in gated communities or societies. This reduces the price per household to some extent. However, increasingly new technologies that automate certain processes and use less energy are emerging in the market. These systems are priced low and targeted at low-income households in vulnerable communities. For example, Wetlands Work! in Cambodia treats waste water using biological technology that requires minimal operational cost and can serve the floating households of poor people in Cambodia at a scale.

#### Financial Viability

The wastewater treatment market in developing countries such as India is highly fragmented. Enterprises compete on the basis of cost, technical expertise, experience and brand equity. For large municipal and industrial projects there is a pre-bidding process, and hence expertise and past experience with credible or well-known clients are critical factors. Enterprises that offer energy-efficient solutions at competitive costs are likely to find a larger slice of the wastewater treatment market.

Industrial wastewater treatment plants have a breakeven period between 3-8 years, due to the high capital costs. Profitability depends on whether the treated water is reused by the industry, thus reducing dependence on 'new' water. The average margins in this industry depends on the country, grants and customer base, but generally varies from 10 percent to 35 percent<sup>14</sup>. To streamline costs, companies like VA Tech Wabag in India have built captive power plants which utilize the sewage to produce energy. The green energy generated from such projects is also eligible for carbon credits. Triveni Engineering, another company in the wastewater sector, builds and operates sewage treatment in municipalities and desalination projects, and sells the treated

<sup>12</sup> JNNURM was a city-modernization scheme launched by the Government of India with an investment of USD 20 billion

<sup>13</sup> <http://economictimes.indiatimes.com/business/vision-earthcare-turning-sewage-into-potable-water/articleshow/6881949.cms>

<sup>14</sup> Primary interview with Agua Inc

water to industries. Hence, it has an additional revenue stream that helps in covering wastewater operating costs and achieving higher profitability. Business models like these can make large-scale wastewater management projects viable.

For domestic wastewater treatment plants, the customer base presently is small as there is limited awareness and willingness to install a system within homes or work premises. Many environment-conscious residential apartments and housing societies have begun to accept and adopt these wastewater treatment plants that also reduce their costs of managing sewage. Wastewater treatment enterprises are partnering with large developers and builders to install systems in metropolitan cities.

#### Partnerships

Wastewater enterprises working in low-income communities generally work closely with corporates, educational institutions, government, NGOs and other waste sector stakeholders. Their objectives for partnership include product development, awareness creation, or creation of marketing and distribution channels. For example, Ecosoftt works with Gram Vikas, World Toilet Organization, and Environmental & Water Technology Centre of Innovation, Singapore. It also works with Autodesk as a CleanTech partner. Ecosoftt also received a grant from Design Singapore Council to advance the design of a unique product within its Water SMART Homes & Communities platform.

Many international organizations and Governments of developed countries have also started programs to support innovative enterprises in developing countries that are scalable and have the potential to make a significant impact in the waste sector. Waste enterprises participate in these programs to develop their technologies and manage initial costs. For example, Wetlands Work!, an enterprise in Cambodia, has partnered with multiple stakeholders to develop its products. It received financial support of USD 100,000 from the Bill and Melinda Gates Foundation to develop a proof-of-concept for a floating community sanitation solution called HandyPod. WW! is also a part of Sustainable Sanitation Alliance (SuSanA). WW! is active in the Water and Sanitation cohort in the Ministry of Rural Development of Cambodia which has partnered with the World Bank Water and Sanitation Program. Other WW! partners include Save the Children, a (World Bank funded) Early Childhood Development program in floating communities, local NGOs supported by UNICEF for floating school sanitation, and People in Need and other organizations for flood prone sanitation. Support for the present sanitation marketing scale up of the HandyPod comes from a grant to WaterAid Cambodia from Canada's Grand Challenges for Global Health Fund, for which WW! has partnered with WaterAid. Conservation International and Engineers Without Borders have also supported WW!.

### Implementation: Delivering Value to the Poor

#### Awareness

Wastewater treatment enterprises have dedicated staff to reach out to residential communities and industries to explain their treatment process and the potential benefits. Some enterprises conduct roadshows in rural areas on the harmful effects of untreated wastewater, while some industrial wastewater system manufacturers approach industry associations to reach out to network processing companies for sourcing customers. Other enterprises spread awareness about general hygiene and environment protection in local schools and communities. For example, Ecosoftt runs a program called AQUA that embeds concepts of water, wastewater and environment protection into the curriculum of schools, colleges and institutes for higher learning. Ecosoftt has developed a set of curricula and learning paths to enable students of various age groups to become aware of water and environmental issues. Ecosoftt also has an initiative called Solutions for Underprivileged Lives (SOUL), which is a community-led transformation program that ensures that underserved and marginalized communities can obtain access to clean water, recycling and reuse of wastewater, basic sanitation facilities, and improved livelihood opportunities. Through this program, it raises issues related to health risks from untreated wastewater, encouraging many of the community members to sign up for its systems.

### Acceptance

To improve acceptance of wastewater treatment systems, enterprises provide a range of sizes of the system to apply to different quantities of waste. These solutions fit specific needs and are scalable to cater to future requirement. They also offer speedy installation to gain acceptance among the households. For example, Vision Earthcare, an enterprise in India, produces systems that can be customized to residential client requirements. In the system, the sewage water is passed through the specialized media and as the water is filtered down through it, the sewage is converted into potable water within four hours. The technology is referred to as soil biotechnology. This reduces overall water consumption by 40-45 percent. These improvements make the wastewater systems more readily accepted by non-commercial clients.

Visio Earthcare takes only seven days to setup a plant

Industrial wastewater treatment enterprises that offer end-to-end waste management solutions find ready acceptance. For example, Bridgedots in India has a specialized R&D team, which develops technology solutions for waste treatment that not only help in removal of hazards from waste, but also in waste utilization. It develops waste treatment technology for extraction of valuable components from the waste and removal of hazardous material from the waste<sup>15</sup>. Bridgedots helps its clients to comply with industry regulations and environmental specifications of waste water management. It develops innovative solutions for capacity increment and technology upgrade, and recovery of useful materials from sludge. It also conducts water audits for its clients in collaboration with expert professors and consultants.

### Accessibility

Many communities do not have regular access to clean water. However, last-mile delivery and service is not always commercially feasible for water treatment enterprises. Some enterprises have, therefore, started a franchise model in which the reseller is also one of the beneficiaries. For example, Saha Global, a non-profit enterprise in Northern Ghana, trains local women to be water entrepreneurs in communities that lack clean water. The women fetch water from their local surface water source to fill three 200-liter drums. They use alum to remove the particles from the water, leaving it clear. This clear water is moved to a polytank where it is treated with chlorine. Saha Global Field Representatives distribute Safe Storage Containers to every family in the community. These 20-liter buckets have a lid and a tap, which helps to prevent water re-contamination in the home. One Safe Storage Container provides enough drinking water for 2-5 days depending on the size of the family.

In most of Saha's partner communities, people walk less than half a mile to the water treatment center

### Affordability

In water-stressed rural regions, standard waste water treatment plants for potable and drinking purposes are prohibitively expensive. A localized solution at the community level through which the consumers can also contribute towards water purification is more affordable and sustainable. For example, Saha Global does not drill wells or use imported pumps that often break down. All of the water is transported by hand from the dugout, treated by hand in the village and then carried home by the consumer. 100 percent of the revenue from the water businesses stays within the community and is managed by the women entrepreneurs, and is used to cover the cost of the water treatment materials and to compensate the entrepreneurs for their work. The women sell the clean drinking water to their community for a small fee. The community works with the women to determine an affordable price.

The average water price in Saha's partner communities is 3 cents per 20 liters of water

<sup>15</sup> Industrial effluent contains various contaminants such as feedstock materials, byproducts, product residues, washing/cleaning agents, solvents, and other functional products like plasticizers



For water polluting industries and processing plants, affordability is countered by their need to adhere to a government mandate. Further, if they can reuse water, they perceive added cost savings.

## Results and Cost-Effectiveness

### Scale and Reach

Treatment of wastewater is often driven by government mandate (industrial users), and the desire to save the environment and reduce dependence on municipal fresh water (for residential users). Hence, enterprises catering to industrial users find it easier to scale faster by focusing on industries that produce significant waste water. Enterprises catering to residences, schools, and apartment blocks may find it more difficult to convince target customers of the cost effectiveness of their solutions.

Industries generate different types of waste depending on the chemical processes they employ. Generally, wastewater systems are built to focus on one or a few of these processes. An industrial wastewater management manufacturer may therefore be restricted in its ability to treat different contaminants, as it may have the IP and technical expertise only for a particular treatment process suited only to one sector. This may in turn restrict its scalability and expansion to other industries. As a business model, wastewater treatment systems are quite scalable geographically. This is because the process is standardized and easy to replicate. Manufacturing can also be centralized with a franchise model for marketing and selling.

Enterprises with treatment systems that have a flexible capacity find it easier to scale. For example, in Haiti non-profit organizations Engineers Without Borders and Partners in Health teamed up to install a 30 x 45 m<sup>2</sup> wastewater treatment facility in a hospital with a donation-based budget of less than USD 250,000. The system can accommodate a flow rate of more than 300 m<sup>3</sup> per day of cholera-infected waste. It is scalable according to the needs of the hospital and can handle fluctuating flow rates. It can be installed in less than a day and can be operated without technical expertise as well. Such systems are replicable and can reach all those areas that have poor wastewater treatment infrastructure.

**Table 2. Scale at which some wastewater enterprises operate**

Company	Years	Scale
Saha Global	8	Launched 93 clean water businesses
Triveni	32	1000 industrial units of average capacity 30 MLD <sup>16</sup> installed
SFC	13	30 industrial units of average capacity 40 MLD installed
PT. Tirtakreasi Amrita	26	200 plants built of average capacity 0.3 MLD

### Improving Outcomes

Wastewater treatment enterprises produce outcomes that are beneficial not only to the consumer, but also to the society at large. Wastewater treatment reduces the amount of waste released into the environment, and has an impact on health risks associated with environmental pollution. It also reduces the freshwater loss induced through water pollution. Wastewater treatment reduces the amount of money spent by a country on environmental rehabilitation projects required to battle pollution. Household wastewater systems can help in recycling wastewater for reuse. For example, Ecosoftt’s Water SMART Homes & Communities platform allows water sustainability through a 3-pronged approach: reduce water footprint and wastage by up to 50 percent, recycle and reuse up to 80 percent of wastewater for non-potable purposes; and discharge the balance 20 percent in an environmentally friendly way. Ecosoftt also has a product called Sulabh Waste-to-Energy, which brings the double benefit of reducing sludge from the wastewater treatment process while producing biogas beneficial to the community.

<sup>16</sup> MLD refers to million litres of wastewater treated per day

Waste water enterprises catering to industrial customers also help them meet environmental norms. For example, PT. Tirtakreasi Amrita in Indonesia has a concept of integrated waste management with zero discharge that reduces Green House Gases (GHG) and enables its clients to generate Certified Emission Reductions (CERs)<sup>17</sup>. Some enterprises enable livelihoods generation along with sustainable access to treated water in local communities. In 7 years, Saha Global has provided jobs to 178 women entrepreneurs in northern Ghana. Most of the women are farmers who sell safe water to earn additional income. For a family living on less than USD 2 each day, the money the women earn from the water treatment business is significant and is invested in children's health and education.

#### Cost-Effectiveness

The technology used by wastewater treatment enterprises has a significant bearing on the cost-effectiveness of their business model. For example, Vision Earth Care's treatment plants use a novel high-efficiency natural oxidation process to replace the use of heavy blowers for oxidation in conventional technologies. The plants are built to be easy to run with virtually no maintenance, reducing operational & maintenance cost by 60 percent from the operating cost of a conventional sewage treatment plant. Similarly, Agua Inc., Kenya, has devised an innovative way of treating industrial waste water using floating green filters, a biological water treatment method that uses a combination of hardware and macrophyte phytoremediation plants, a species of aquatic plants.<sup>18</sup> This biological mechanism reduces the prohibitive costs associated with waste water treatment.

Some enterprises provide advanced wastewater treatment systems that make on-site treatment of wastewater within homes and residential communities highly effective compared to other systems. For example, Ecosoft has systems such as Aerobic Biofilters Without Sludge (ABWS) that consumes 70 percent less energy than conventional activated sludge systems. It is also compatible with solar energy and incurs low installation and maintenance costs. Additionally, consumers can produce rich organic fertilizer as by-product which can be revenue-generating. Similarly, Greywater Tech (Jaldhara) manufactures and sells both household and industrial wastewater systems that are 20 percent-50 percent smaller than conventional systems, require no on-site fabrication, and have very little operating costs in terms of electricity and monitoring.

Many enterprises have developed affordable solutions to not only treat polluted water, but also produce by-products that can be sold or used to cover the cost of the water treatment. For example, AcuaCare, a household waste treatment enterprise in Colombia, packages worms, microbes and enzymes into biodegradable, cardboard-box "treatment systems" which purifies water through a process called vermifiltration<sup>19</sup>. A USD 170,000 AcuaCare installation for 1,000 people produces 32 tons of organic fertilizer annually, worth about USD 12,000 in Colombia<sup>20</sup>. Every year, the system also yields 3 tons of excess earthworms that can be used to make animal feed, worth about USD 7,200. These products are in addition to a steady supply of water for crops, gardens or public spaces, which would cost about USD 25,000 a year from the local municipal water system. With proper maintenance, an AcuaCare system

According to the Foundation for Mother and Child Health Indonesia, on average, the benefits of investing in wastewater management, sanitation, and hygiene range from USD 2-3 per dollar invested

<sup>17</sup> Based on Kyoto Protocol (1990) the industrial countries can take credit of CERs from developing countries issued by the Executive Board. The Clean Development Mechanism (CDM) in developing countries such as Indonesia, Brazil, China, India etc, which aims to reduce carbon emission, helps the industries in industrial countries (EU, Japan, Canada etc) to fulfill their carbon limit by buying CERs from the developing countries.

<sup>18</sup> The ability of macrophytes to hyper-accumulate heavy metals makes them a natural waste water purification method, especially for the treatment of industrial effluents and sewage waste water.

<sup>19</sup> A cheaper alternative to septic tanks. Unlike traditional septic tanks that simply filter feces from the water, leaving toxic sludge for later disposal

<sup>20</sup> <http://www.ozy.com/rising-stars/juan-carlos-guqueta-the-colombian-worm-king/60199>

lasts for 15 years and breakeven is estimated to reach in 4 years<sup>21</sup>. AcuaCare also uses 80 percent less energy and has operating costs 70 percent lower than conventional water filtration — particularly by decreasing water use.

There are innovations in industrial wastewater treatment too that reduce costs and make the treatment process cheaper than conventional systems. For example, SFC India has come up with Cyclic activated sludge technology (C-Tech) for biological treatment of all effluents that makes sludge treatment highly cost-efficient. C-Tech consumes 50 percent less power and 50 percent less land area compared to other traditional technologies. It also requires less costly material<sup>22</sup>, is also fully automatic and does not require constant operator attention. The treated sewage/effluent can be used for horticulture, green belt development, and industrial applications like cooling tower.

Scaling Up

Challenges

The major challenges for the water treatment sector include technical barriers, sub-optimal markets for recovered nutrients, lack of awareness of the economic value of water, lack of resources for full-scale implementation and validation of innovative solutions, and lack of knowledge with regard to the occurrence of emerging pollutants. Wastewater plant operators also have trouble maintaining complicated systems while keeping costs low. In their innovation journey, enterprises often face a challenge after they develop a prototype, due to lack of financial resources for further development, customization, demonstration and commercialization. There is a lack of demonstration sites for new technologies to customers due to the capital-intensive nature of such large-scale demonstration in relation to their perceived economic value. Also, the cost of certifying multiple products in multiple countries is prohibitive, resulting ultimately in a limitation of technologies to only few large scale processes per country that justify the approval cost. This ultimately leads to adoption of sub-optimal technologies.

Energy consumption is one of the largest expenses in operating a wastewater treatment plant. In municipal wastewater treatment, the largest proportion of energy is used in biological treatment, generally in the range of 50 percent - 60 percent of plant usage<sup>23</sup>. Another challenge for industrial wastewater treatment is the requirement for land to construct the plants. Activated sludge plants are expensive to construct and occupy substantial land areas. Primary and Secondary processes rely upon vast tracts of land for large and expensive settling tanks and aeration basins.<sup>24</sup>These processes may not be economically viable for all industries and hence lead to lower adoption. Newer technologies are aiming to reduce the space and capital outlay required to achieve the same level of treatment through alternative processes.

Role of Government and Policy

National Governments of various developing countries have strengthened water quality standards and are progressively limiting wastewater discharges. For these reasons, most countries recognize that industrial wastewater treatment provides a substantial public good, and national budget funds subsidize at least a part of local wastewater treatment. Given the low level of demand for wastewater services, especially treatment, government regulation becomes an important factor in fostering that demand. Regulation (imposing standards on wastewater discharges by both industry and local government) has been

Many developing countries suffer from political interference in environmental decisions such as site selection and other aspects related to construction and operation of wastewater plants

<sup>21</sup> The expenses include: 1. Personnel (USD 25,000) 2. Materials and Equipment (USD 20,000) 3. Domestic travel for wastewater sample collection (USD 5,000)

<sup>22</sup> It uses all underwater metal parts in stainless steel, resulting in higher plant life and low maintenance costs

<sup>23</sup> <http://info.oxymem.com/blog/4-major-operational-challenges-facing-wastewater-treatment-plants>

<sup>24</sup> United Nations Environmental Program

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critical in fostering compliance. Enforceable regulation has been found to be critical in allowing economic incentives to work.

For residential communities, treatment is usually the responsibility of agencies that also provide piped drinking water. These agencies may be municipalities, county Governments, or separate special-purpose authorities. User charges for wastewater are generally tied to piped water consumption, at least for those users that discharge into publicly provided sewage systems. However, since user fees alone are generally insufficient to repay capital costs, social enterprises are developing innovative technologies for decentralized treatment of wastewater at the household level and working with the local Government to sell them.

In recent decades, compliance with Government wastewater quality requirements has been the primary driver of industrial wastewater treatment programs in developing countries. Most Governments mandate wastewater treatment for industries. Industries are supposed to abide by the Government wastewater quality requirements for the specific concentration limits of the wastewater discharged. The regulations governing the recovery of wastewater, however, vary across countries. Some Governments actually authorize the use of treated wastewater to irrigate crops or water green spaces. Since this is an added cost for the processing industries, governments often provide incentives such as tax credits or rebates.

Government regulations in most countries usually rely on the recommendations of the World Health Organization (WHO). In India, for example, the Zero Liquid Discharge (ZLD) or Zero Discharge (ZD) Policy has been drafted by the Ministry of Environment and Forest (MoEF) and Central Pollution Control Board (CPCB). Currently, only a few states and specific industrial end users like textile and automobile manufacturers and breweries are mandated to achieve ZLD status. It is expected to be implemented uniformly all over the country in the coming years. In Malawi, the Government the requirement to treat wastewater is underscored by the existing regulatory framework, institutional arrangements, and policy guidelines. One of the specific goals in the National Water Policy (NWP) (Malawi Government, 2005) is to ensure water of acceptable quality for all needs in Malawi. In addition, formalized national effluent standards exist in Malawi (Malawi Bureau of Standards, 2005). In Indonesia, the Central Government has adopted a national policy to promote private sector participation in BOT projects for tourist hotels and water supply source works. The Government is also aiming to solidify the regulatory environment and develop mechanisms whereby local water authorities can enter into joint ventures and enforceable contractual arrangements with the private sector.

Governments also support research and development of innovative and cost effective technologies to treat waste water for reuse. The Centre for Science and Environment has proposed to set up India's first referral laboratory for fecal waste to support planning, design and implementation of effective fecal waste management systems and mainstreaming decentralized wastewater treatment. The National Urban Sanitation Policy (NUSP), 2008, endorses reuse of reclaimed water, and recommends a minimum of 20 percent reuse of wastewater in every city. In the last few years, the Government of India has taken many concrete steps to promote reuse of wastewater. It began with regulating industrial water consumption and enforcing mandatory water reuse targets for industries.

Most governments, however, face significant challenges in enforcing laws and implementing their plans to recycle and reuse wastewater. Governance of the water sector is characterized by complicated regulatory responsibility across political hierarchy levels that result in fragmentation (e.g. different regulations and standards per region). Although wastewater reuse is endorsed in many policies and programs, there is a lack of clear guidelines and frameworks to support the implementation of such projects. As a result, the reuse of reclaimed water for non-potable purposes continues to face challenges. The problem is further exacerbated by limited enforcement of the restriction to extract groundwater for non-potable purposes.

While financial support of international organizations and developed countries is essential, it is imperative that local conditions are considered to make full use of any aid. The adoption of inappropriate technology and failure to take into consideration the local conditions of the targeted community result in project failure that is often blamed on the lack of technical know-how. In addition, government support is needed for environmental education and public awareness and participation.

## Conclusion

While the wastewater treatment industry is growing rapidly, there continues to be a huge gap between wastewater generation and treatment. Although the potential market for water treatment enterprises is fairly large, demand for water treatment and management is driven primarily by stringent government policies prescribing and mandating wastewater treatment. Other factor such as increasing industrialization, demand for freshwater and increasing urbanization in emerging markets of Asia Pacific and Latin America will also drive water and wastewater treatment demand.

While the market for household wastewater systems is less developed, increasing environmental concerns and irregular water supply are driving the growth of systems that not only treat waste water but also enable its reuse. Wastewater treatment enterprises operate in a push market, where they are also tasked with market creation. They face a capital crunch from the initial research and development phase to commercialization. This is not helped by the unit economics of the model, where individual plants are expensive.

Government assistance, financial and regulatory, as well as support from development financial institutions is needed to boost this business model. As treatment processes become more cost-effective, the adoption of the wastewater systems by both residential and industrial consumers is bound to increase rapidly.

**Table 3. Social enterprises in wastewater treatment**

Company	Country	Solution description
AcuaCare	Colombia	The technology used by AcuaCare allows biological treatment of wastewater using earthworms and microorganisms which transforms the pollution in the water into organic fertilizer and allows the reuse of the treated water for irrigation. <a href="http://www.ozy.com/rising-stars/juan-carlos-guqueta-the-colombian-worm-king/60199">http://www.ozy.com/rising-stars/juan-carlos-guqueta-the-colombian-worm-king/60199</a>
Agua Inc	Gambia, Dominican Republic, Mali, Spain, Kenya, Haiti	Agua Inc. has devised an innovative way of treating industrial waste water using floating green filters, a biological water treatment method that uses a combination of hardware and macrophyte phytoremediation plants, a species of aquatic plants. <a href="http://aguainc.com/">http://aguainc.com/</a>
Bridgedots TechServices	India, Europe, Middle East, USA and Australia	Bridgedots provides services related to industrial solid waste and wastewater treatment. <a href="http://www.bridgedots.com/">http://www.bridgedots.com/</a>
Ecosoftt	Singapore, India, HongKong	Ecosoftt's Solutions for Underprivileged Lives (SOUL) programme is a community led transformation program that ensures underserved and marginalized communities can obtain access to clean water, recycling and reuse of wastewater, basic sanitation facilities, and improved livelihood opportunities. <a href="http://ecosoftt.org/">http://ecosoftt.org/</a>
Greenenvironment Innovation and Marketing	India	Greenenvironment undertakes fresh water and recycled water management contracts in urban apartment complexes. Greenenvironment monitors real-time water and wastewater treatment

		systems in apartment complexes helping them significantly reduce their water consumption. <a href="http://greenviromentindia.com/">http://greenviromentindia.com/</a>
Grey Water (Jaldhara Technologies Pvt. Ltd.)	India	Grey Water offers a unique range of highly compact, plug and play, modular waste water treatment and water recycling products for residential and commercial buildings, hospitality and industrial sectors. <a href="http://www.greywatertech.com/">http://www.greywatertech.com/</a>
PT. Tirtakreasi Amrita	Indonesia, Srilanka, Nepal, Vietnam and Nigeria	PT. Tirtakreasi Amrita makes treatment plants ranging from drinking water, sewage treatment, to complex industrial effluent treatment plant for various industries. <a href="http://www.amritaenvironmental.com/">http://www.amritaenvironmental.com/</a>
Saha Global	Ghana	Saha Global empowers women in rural communities to solve their village's need for clean water and electricity by providing business opportunities. <a href="http://sahaglobal.org/">http://sahaglobal.org/</a>
SFC India	India	SFC supplies Cyclic Activated Sludge Technology (C Tech), an advanced sequential batch reactor technology. This technology is extensively used for treating domestic sewage and industrial effluents. The treated sewage from C Tech plants can be recycled for industrial applications, gardening, agriculture and other applications. <a href="http://www.ctechsbr.com/home.php">http://www.ctechsbr.com/home.php</a>
SKS Infrastructure	India	At SKS, waste water treatment initiatives are geared at treating the organic, inorganic and heavy metal contaminants in waste water (sewage and effluent) to facilitate re-usability in centralized as well as decentralized manner. <a href="http://sksinfrastructure.com/">http://sksinfrastructure.com/</a>
Synergy Energy Limited	India	Synergy provides integrated bio-medical waste management services. It collects bio-medical waste through its Common Bio-Medical Waste Treatment Facilities (CBWTF) that caters to a number of health care establishments. It then disinfects and treats the waste through incineration, autoclave and shredding. <a href="http://www.synergyworld.co.in/index.html">http://www.synergyworld.co.in/index.html</a>
Triveni Engineering & Industries Ltd	India	TEIL's Water Business Group (WBG) offer products and services that cover the entire spectrum of water treatment desalination, waste water treatment and recycle for industries, infrastructure and municipal projects. <a href="http://www.trivenigroup.com/water-solution-microsite.html">http://www.trivenigroup.com/water-solution-microsite.html</a>
Vision Earthcare	India	Vision Earthcare provides effective eco-friendly solutions to water treatment across all scales. Its services include design and turnkey execution of soil biotechnology. <a href="http://www.visionearthcare.com/">http://www.visionearthcare.com/</a>
Wetlands Work!	Cambodia	Wetlands Work! is a social enterprise that designs and builds innovative constructed wetland systems to treat various contaminated waters, to allow reuse or safe release into the environment. <a href="https://wetlandsworld.com/">https://wetlandsworld.com/</a>

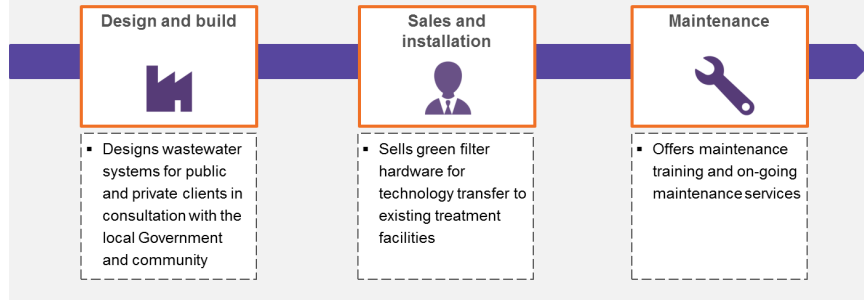
## CASE STUDY: AGUA INC



**Founding year:** 2013  
**HQ:** Colorado  
**Countries of operation :**  
 Gambia, Dominican Republic,  
 Mali, Spain, Kenya, Haiti  
**Orientation:** For-profit  
**Employees:** 40  
**Turnover:** USD 1 – 2 million

Typical water treatment technologies entail very high costs, complex maintenance, and environmental impacts. Agua Inc. is an innovative water and wastewater treatment technology company and facility developer, that provides cost-effective and energy efficient solutions for municipalities around the world. It transforms the unit economics of wastewater treatment by building facilities that are 50% less expensive to construct and operate, making wastewater treatment more profitable.

It's proprietary biotechnology system naturally clean contaminated water sources and wastewater more effectively, more sustainably, and more affordably than traditional treatment technologies. The firm uses its innovative ABIS (Aquatic Biological Integrated Systems) water-treatment method which filters water through matrices of floating plants.



### Operating Model

Nearly 90 percent of wastewater in emerging markets remains untreated when discharged, resulting in surface water contamination and the rapid growth of dead zones in rivers and oceans<sup>25</sup>. This also has health implications for surrounding communities as at least 1.8 million children under five years old die every year from water related diseases. In emerging markets, unsafe water is the number one cause of disease and death in these communities. However, most conventional approaches require large quantities of reliable energy supply and chemicals which are simply not available in most developing countries.

Agua Inc., a biological wastewater treatment enterprise has devised an innovative water treatment method which filters water through matrices of floating plants. Agua uses a combination of specialized plants (PhytoTech), hardware (BioHardware), and filter materials (BioFilters) to naturally and effectively treat water for a variety of applications (wastewater treatment and recycling, drinking water purification, etc). Additionally, the ability of macrophytes to hyper-accumulate heavy metals makes them a natural wastewater treatment method for industrial effluents. Agua systems replace conventional machines with its innovative and affordable treatment method called ABIS (Aquatic Biological Integrated Systems), which achieves similar treatment processes with biological methods.

<sup>25</sup> United Nations Environmental Program

Agua Inc's team has experience participating in over 200 projects until date. Today, its target market includes wastewater treatment plant facilities, local and international governments, international development organizations, private investors, corporate social responsibility arms, NGOs, and national utility regulators. It engages the local community to understand their needs and designs the system accordingly. One of the ways in which it does local outreach is sponsoring local football teams. Agua is also a partner in the Global Wastewater Initiative (GW2I), a multi-stakeholder platform to initiate comprehensive, effective and sustained programmes addressing wastewater management.

**Agua optimizes conventional biological treatment processes with specialized biotechnology including custom breed macrophytes and bacterial communities, bio-engineered absorbents, and hardware to increase performance and decrease costs and maintenance.**

Agua undertakes both new builds and upgrades to existing facilities. In upgrade projects, Agua sells green filter hardware, as well as specially bred phytoremediation plants, to existing water treatment systems. In new build projects, Agua works with municipal corporations to provide customized turnkey wastewater treatment facilities that are fully constructed and ready to operate. After the completion of the project, it hands over the operations of the facility to the client and offers maintenance training and on-going maintenance services.

In addition to building new facilities and maintaining them for clients, Agua offers a Utility Development Program, where the enterprise takes over wastewater treatment system development and operations from city municipalities. Based on a comprehensive analysis of the municipality's system, Agua's engineering team designs a customized upgrade plan for the system. It signs a concessionary agreement which gives Agua the right to operate the facility and provide wastewater treatment services to its users. Agua works with its network of private and institutional investors to raise the appropriate funds to pay for the upgrade. Agua Inc assumes operations of the facility and appropriate upgrades are installed. It continues to operate the facility ensuring quality service provision to all users. Under this model, revenue is generated by charging either the appropriate utility or government counterpart for service provision and allowing them to charge end users, or charging consumers directly.

#### Financial Sustainability

Agua incurs major costs on maintenance of the plant, leasing and the pipe networks, and it generates revenues from design-and-build projects and Concessionary/Build-Operate-Transfer deals (upgrading and operating wastewater treatment facility as a service). Agua's systems are generally designed to be energy efficient and chemical free. As a result, the enterprise is able to save on electricity (making up over 25 percent of average facility operating costs) and chemicals (25 percent of operating expenses) as compared to traditional wastewater systems.

Most wastewater treatment facilities generally require Government subsidies to meet the gap between income generated from operations, and the costs of development and on-going operations. Agua has implemented a unique financing method to make the project cost-effective, wherein the Government gives Agua a concession - a lease to lands and lagoons. The enterprise then brings private investors to upgrade the system and the public pays the same price preset by the Government, but to Agua instead of the municipal corporation. Through significant cost savings in operations and revenue collection optimization processes, Agua delivers improved treatment at a reduced cost. This results in reduced subsidies, and in many cases a fully financially sustainable business.

**Because of Agua's higher capacity, innovative technology and refined operations, Agua systems cost on average 50% less to build and maintain than traditional systems**

#### Impact



Agua's waste water treatment system has the ability to buffer highly polluted effluent, allowing for effective long-term treatment. Besides, the system eliminates odors and improves the sites natural aesthetics. It is highly adaptable and can eliminate pathogens, fecal matter, heavy metals and contaminants from various water sources without chemicals and minimal energy use. The system does not require much specialized technical expertise and can be locally run creating direct employment and indirect income generating opportunities from water related activities. Additionally, it also generates clean water for reuse in agriculture and industry and restoration of waterways and aquifers. This biological mechanism reduces the prohibitive costs associated with wastewater treatment. Agua also creates impact by spreading awareness about vaccination and gives health insurance to all its employees

Agua's facility in Gambia manages the Kotu Wastewater Treatment Facility and Sanitation Network which services a population area of 200,000 inhabitants

### Challenges and Lessons

The ABIS technology by Agua can be applied to a wide range of water treatment applications; however, it faces some operating constraints, for example ABIS is not normally recommended for highly saline wastewaters. Additionally, ABIS is most appropriate for warm to temperate climates, and is not suited to far northern environments with harsh winters unless a greenhouse is constructed. Agua also depends completely on local municipal corporations as its clients and winning the tender and executing a contract is a tedious process for it. Agua Inc is also facing some financing constraints and is looking to raise external funds.

### Road Ahead

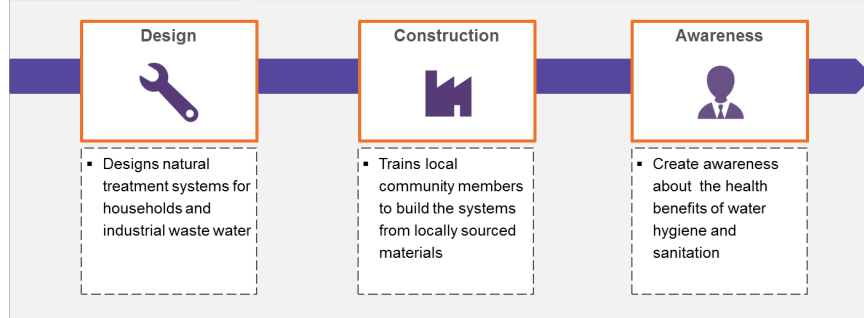
Agua aims to not only make water and wastewater treatment more sustainable and more affordable, but ultimately transform a generally subsidized industry into one that can improve environmental and public health, while providing good jobs and maintaining financial viability. By making the offering of these basic services financially sustainable, the company's objective is to catalyze increased investment in infrastructure to close the water and sanitation development gaps that still remain prevalent in emerging markets.

## CASE STUDY: WETLANDS WORK!

### Wetlands Work!

**Founding year:** 2011  
**HQ:** Cambodia  
**Countries of operation :** Cambodia  
**Orientation:** For-profit  
**Employees:** 6  
**Turnover:** Pre-turnover

People living in the floating villages of Tonle Sap lake in Cambodia suffer from health issues often related to poor sanitation and water contamination. Social enterprise Wetlands Work! In Cambodia designs practical solutions to treat polluted water. It specializes in innovative wetland water systems and its latest project, HandyPod is being implemented in Cambodia as an appropriate solution for floating community sanitation. It also offers consulting services to build and implement low cost technical designs. It can address a variety of wastewater types, and have unique and practical treatment systems for sanitation in floating communities as well as for households in flood prone environments.



### Operating Model

Globally, poor sanitation and contaminated industrial effluents exacerbate child mortality and human health, decrease the availability and access to safe water for consumption, food-related uses, and washing, and degrade vital habitats. Millions of people worldwide face annual or episodic flood events which co-mingle waste waters from many sources, leading to significant health issues for populations over large geographic areas. Wetlands Work! (WW!) is a social enterprise in Cambodia that has developed innovative solutions for sanitation in flood-prone environments and other contexts. It designs and builds constructed wetland systems to treat various contaminated waters, to allow reuse or safe release into the environment. One of the designs is a three stage treatment system for flood-resilient sanitation for populations living in such extreme environments. The system significantly improves upon current practices in excreta disposal and management in seasonally high groundwater table areas, as well.

**Wetlands Work! develops technology to treat water using biological processes that break down contaminants and disable pathogens.**

Wetlands Work! in Cambodia designs practical solutions to treat polluted water. It specializes in selling low-cost innovative wetland water systems to low-income communities living in flood-prone areas of Cambodia. It also offers consulting services to build and implement low cost technical designs. It can address a variety of wastewater types, and have unique and practical treatment systems for sanitation in floating communities as well as for households in flood prone environments.

In nature, wetland and floodplain plants help to remove contaminants from water, while at the same time supporting a variety of species including fish, birds, mammals, amphibians, insects and aquatic invertebrates and microbes. Wetlands can be created to convert contaminated water into potable water. Wetlands Work! designs ecologically engineered water treatment processes to transform domestic sewage and other waste streams into improved water. It uses common wetland plant species to provide an active root surface area,

attached to which are trillions of microbes that break down waste into food usable by numerous other organisms in the system. Thus, Wetlands Work! designs can be applied to communities in need of sustainable, low-cost access to improved water.

The water produced from constructed wetlands can be recycled for reuse, and can even be treated further to meet WHO drinking water standards. Some of WW!'s models can be used in off-the-grid rural areas, including those where poor, marginalized people live. At the household level, a simple WW! system can be set up in several days, using inexpensive, locally available materials. For larger systems, WW! takes around a month to construct and install the system.

WW! is part of Sustainable Sanitation Alliance (SuSanA). WW! is active in the Water and Sanitation cohort in the Ministry of Rural Development of Cambodia which has partnered with the World Bank Water and Sanitation Program. Other WW! partners include Save the Children, a (World Bank funded) Early Childhood Development program in floating communities, local NGOs supported by UNICEF for floating school sanitation, and People in Need and other organizations for flood prone sanitation. Support for the present sanitation marketing scale up of the HandyPod comes from a grant to WaterAid Cambodia from Canada's Grand Challenges for Global Health Fund, for which WW! has partnered with WaterAid. Conservation International and Engineers Without Borders have also supported WW!.

The HandyPod is one of the flagship products of Wetlands Work! It is a simple and reasonably affordable set-up that provides people their own in-house toilet as well as treatment of their wastewater. Wetlands Work!'s simple sanitation system is made up a settling tank and a biofilter. The HandyPod is connected to the toilet in a floating house and captures the sewage treating it to remove pathogens and nutrients. Tests have shown that the system removes high levels of E. coli bacteria from the sewage. The design takes only 2 m<sup>2</sup> of space. It relies on gravity flow and an appropriate retention period for anaerobic and aerobic microbial activity, and no energy, electrical, or chemical systems are required. WW! has partnered with a social enterprise, Ideas at Work, that manufactures the HandyPod systems for floating houses.

Wetlands Work! partners with local community groups to train them to install the systems. In sanitation for challenging environments, WW! works in 10 communities and 2000 households across 10 villages. It has numerous potential commercial customers in industries such as garments and silk textiles. Wetlands Work! has piloted wastewater treatment design for 49 land-based flood prone households that sit in risky floodwater for up to 6 months of the year. Wetlands Work!'s other projects include treatment designs for contaminated industrial wastewaters, residences and hotels, zoo animal enclosures, and even water treatment for natural swimming pools that do not use chlorine.

#### Financial Sustainability

Wetlands Work! incurs major costs on research, design, and testing of various systems, which includes staff time, materials needed for building prototypes, analyses to gauge performance of the systems, and overhead costs. The focus of the design phase is to build a system at a low cost, by using locally available, natural materials as much as possible, and to ensure that maintenance is minimal. The major revenue streams for Wetlands Work! so far have been grants for testing and piloting of the designs, and consulting fees for design and implementation of the systems. Wetlands Work collaborates with local businesses to supply, sell and install the HandyPods. It aims to develop solutions that can be supplied by local businesses in a sustained fashion. Instead of giving the systems away for free using donor funding, WW! creates and implements

The price of a system for a household in flood-prone area is approximately USD 150, whereas a floating household HandyPod system costs approximately USD 140

programs to engage local entrepreneurs in a sanitation marketing approach. It also generates demand for its product by the families in the villages using the Community Led Total Sanitation (CLTS) process, and engaging children in the communities by installing systems in schools and carrying out sanitation awareness campaigns.

The HandyPod is a low maintenance technology for households in floating communities made up of about USD 140 worth of labor and materials and priced at around USD 180. The system is expected to last 5-10 years, with some repair of the frame performed as needed, similar to what residents of floating households are accustomed to doing with their dwellings. The targets of the HandyPod scale up project are residents of floating communities as well as small business entrepreneurs who will make and market quality HandyPods. The unit economics of making the water system affordable to this very poor population still remains a key challenge. To address this, WW! provides consumer financing through a community loan service.

### Impact

Wetland-based treatment systems create a more visually appealing environment by eliminating the appearance of floating solid waste, mitigating odors and, most importantly, lowering health risks to resulting from contact of sewage contaminated water.

With the implementation of Wetlands Work!, there is increased dignity for users and improved health in the floating communities, most of whom rely on fishing as a source of income. The HandyPod provides convenience to families, eliminating the need for long boat journeys out of the village in search of a private place to defecate. WW! has also developed educational programming for schools and community buildings on the importance sanitation and hygiene.

HandyPod can help reduce child mortality, gut inflammation and diarrhea caused by the pathogen content of the water that surrounds floating communities

### Challenges and Lessons

Wetlands Work! has faced challenges in raising capital for expansion. To tackle this issue, it has hired more part-time staff, who are paid less than their full-time peers. Rather than relying heavily on grant funding for its non-profit systems, such as those for households in challenging environments, WW! is seeking to develop and promote its for-profit systems, such as those for industrial effluents, more strongly. . An additional challenge has been in having the status of a for-profit social enterprise rather than an NGO, which can in some cases result in it being ineligible for certain funding sources.

### Road Ahead

Many large cities in India, Africa and Asia are estimated to explode with rural migration over the next decade due to population growth, jobs, changing climate issues of drought and flood, and exhausted non-productive rural landscapes. These poor landless migrants will have only the most marginal land and water areas to live. Wetlands Work!'s flood-prone and HandyPod technologies will serve as templates to address such large-scale 'safe water' problems. When girls begin menstruation, they may stop going to school because the school does not have appropriate sanitation facilities. WW! aims to solve this issue and provide the schools with sanitation systems.

WW! is in talks with the Cambodian Government to adopt smart subsidies in support of sanitation marketing within poor communities

Wetlands Work! is looking to expand in SE Asia to Myanmar, Indonesia, Malaysia and the Philippines, as well as other flood prone regions such as Bangladesh. It will apply for the Phase II grant from the Canadian Government's Grand Challenges for another 24 months to scale up its sanitation marketing process and geographical expansion. Wetlands Work! has been a semi-finalist for several health and innovation awards including the Reed-Elsevier Environmental Challenge, the Suez Environment Institute de France, and the Civil Society Innovation WASH (Australia) awards and will apply to similar recognition programs in the future.