An Overview of Decentralised Water Supply Options and Safe Water Kiosks as a Viable Option for Affordable Potable Water

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ABSTRACT

Low cost UF technology has recently been applied for disaster relief and low cost community potable water systems. Feedwater conditions can be challenging and difficult in these sometimes marginal applications. Conventional membrane technology has been viewed as "inappropriate" and relatively costly when feedwater conditions are "marginal". It has not been considered a viable option for low cost sustainable potable water supplies. Recent advancements in gravity fed low pressure ultrafiltration membranes have seen extensive deployment of systems in the developing world for both emergency water and medium term water supply. Cost implications are promising. Safe affordable potable water at realistic volumes is now feasible under these difficult conditions via Safe Water Kiosks (SWK's) and Small Water Enterprises (SWE's).These novel "decentralised' solutions are challenging our established views of how to solve the global potable water issue.

A CRITICAL REVIEW OF OUR EXISTING PARADIGM FOR THE DELIVERY OF SAFE AFFORDABLE WATER

High quality "safe" potable water at relatively low cost is a new paradigm for distributed and decentralised water supply. It is time to critically examine if sustainable new paradigms based on technology developments, micro entrepreneurs and novel financing mechanisms can seriously address the entrenched issue of global affordable water supply. We also need to critically assess the context of "safe" water, which does no tangible harm, as being an achievable outcome verses a fully compliant WHO standard that is not easily obtainable. These concepts and solutions are discussed.

THE CONTEXT OF MDG TARGETS

This paper overviews the viability of low cost membrane technology as a tangible solution for community based potable safe water solutions and potentially, SWE's. A new paradigm will be required to achieve the Millennium Development Goals and provide safe affordable water to 1.1 billion people by 2015 [(1)]. The outcome of the Asian tsunami response during early 2005 resulted in new solutions being tested and evaluated. These included gravity UF systems.

At that time the Skyjuice Foundation provided over 200 low cost potable membrane water systems to that crisis response. This program and subsequent evaluations resulted in a new unique solution to low cost community water. Long term field data and operating experience obtained by OXFAM, VEOLIA WATERFORCE and others has validated field performance.

With recent United Nations initiatives in place to accelerate access to pure affordable water [(2)], the recent small UF installations have challenged conventional cost and delivery assumptions. Should funds be expended in treatment or distribution networks?

The proposition is that high quality, affordable decentralised water solutions that utilise new technologies, such as membrane technology should be seriously considered by major health and humanitarian agencies. There is no magic bullet to meet the MDG's. Indications are that there will be a significant shortfall in the MDG target numbers of at least 210 million people [(3)].

Concurrently, we also need to address the 4000 preventable deaths every day [(4)]. A critical assessment of the UNDP "benchmark sustainability criteria" coupled with current SWE actual installed costs of less than 50 cents per person per annum warrant further independent evaluation of the technology. It is time to think outside the box and embark on bold initiatives.

CENTRALISED SOLUTIONS ARE NOT ALWAYS AFFORDABLE FOR BASE OF THE PYRAMID (BOP) COMMUNITIES

Four billion low-income people, a majority of the world's population, constitute the "base of the economic pyramid". New empirical measures [(5)] of their behaviour as consumers and their aggregate purchasing power suggest significant opportunities for market-based solutions that not only address their basic needs for sanitation and water and but meet their aspirational requirements. It is only a matter of time before we see private sector "mechanisms" and initiatives address this unmet demand.

Rapid urbanisation of developing countries (such as China, India and others) is increasing stress on networks. Most countries are not capable of funding or financing the huge public sector capital expenditures. Informal and unregulated network providers and vendors are meeting that demand. In many cases they provide the only viable supply option.

It is imperative that we at least seriously consider alternatives to these centralised networks. Decentralised water and sanitation is the only “logical” choice. New paradigms are required that remove the huge capital cost burden, inject flexibility in service and supply.

There is a widely held view that the BOP suffers a significant penalty in access to safe drinking water. World Bank (World Resources Institute) Household survey data confirms this view. In 9 of the 29 countries for which sufficient data exist For a comparison, the ratio of mid-market households to BOP households with access to piped water is 6:1 or higher. I.e., the poor have less opportunity to access safe water.
Also access to public standpipes reflects a similar pattern—significantly lowers access in the BOP than in the mid market. While BOP households are more likely to use surface water and less likely to have access to piped water, a third alternative, especially in peri-urban areas, is to buy from mobile water vendors. This option typically involves a significant price penalty. One study showed that in eight major cities water vendors charge prices 8–16 times those charged by public utilities [(3)] (UNDP 2005). Another study, covering 47 countries, found that Mobile distributors such as tanker trucks charge unit prices up 10 times the price of piped water.

Commonly where BOP communities lack access to municipal water supply networks, point-of-use water purification and small-scale community-based water purification (probably micro-financed) and waste treatment can be useful solutions. There are community based approaches and innovative programs. One, for example in Orangi, an informal settlement area in Karachi. Pakistan services 1.2 million people.

Left to their own devices people will obtain water in many ways (usually from suspect sources). Some collect it at no “cost” (apart from the considerable cost of their labour) from streams or other surface sources or from wells or community standpipes. Others must pay for it. But households in Africa and Asia will also purchase water from vendors and small-scale community water systems. Current Skyjuice water kiosk projects encourage a user pay philosophy through either, community owned or micro financed kiosks entities.

The private sector is often the provider of last resort. Small-scale water vendors are often the only option in peri-urban communities. Improved point-of-use systems being devised and marketed by the private sector also show promise for giving BOP households better options for water supply, especially in rural areas. New models of community engagement and public-private partnership are emerging. Several players are emerging in the Africa water market. It is interesting to note that the private sector is engaging in this market with hybrid operating models that incorporate a modest “social” profit into their SWK enterprise.

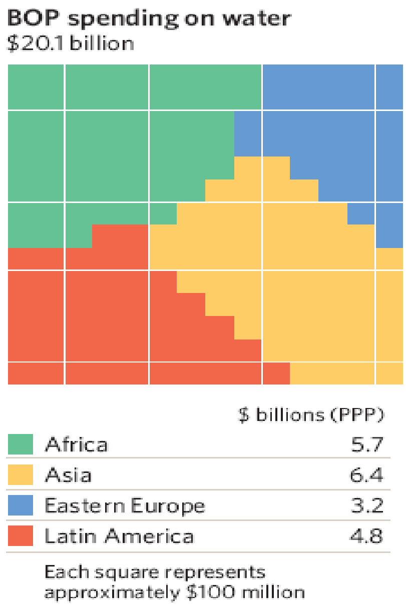

Figure 1: Estimate of BOP spending on water
Source: World Resources Institute Paper: 2006

<u>CENTRALISED SOLUTIONS - AN OVERVIEW</u>

There are many possible options to address the wider global issue. Clearly, the issue is much broader than simply treatment and technology options. However, a cost effective and robust set of technology options is essential. Traditional centralised networks and treatment philosophies have served us well. Capital cost is major structural issue for developing countries.

Let’s examine the benefits of centralised solutions and why they have served us well;

<u>ADVANTAGES</u>

- Controlled and regulated CAPEX expenditure.
- High level of public safety and integrity.
- Uniform service outcomes for all.
- Regulated supply and “hygienic”
- Revenue stream can be captured the assist with ongoing operations.
- “trusted” outputs and delivered free
- Lends itself to government (utility) control regulation and management.

There are disadvantages of these traditional paradigm solutions. They typically can be;

DISADVANTAGES

- Delays in donor funding and access to donor funds, donor obligations.
- Ability of user to pay and collection of revenue from customer base.
- Allocations of treatment cost vs. pipes i.e., 80/20 % expenditure split
- Lengthy period for approval, construction and commissioning.
- Most solutions are site specific and application specific.
- Allocation of headworks/connection fees and ongoing cost and consumption fees
- Vandalism, Water theft and operability.

A network approach based on multiple nodes starting at the end of existing networks is already a common occurrence. For decentralised water systems access to a relatively secure source is not always assured so it is a major priority for site selection. Unregulated water sources, marginal sources or seasonal sources affected by external factors will always be an issue.

WHAT ARE THE DRIVERS FOR DECENTRALISED NETWORKS?

Funding issues are the main drivers forcing the case for small solutions. Sewage and sanitation will always be difficult issues because of the discharge requirements. Potable water solutions have recently been more formalised with the emergence of water kiosks.

Microfinanced solution/ enterprises, community operated enterprises and micro entrepreneur financed models are emerging. These are still typically niche solutions gaining increasing popularity and interest. Africa is a focus region due to the chronic issue of unmet immediate needs.

Existing installations typically revolve round a “point of use” collection model where customers collect water in designated containers rather than distribution through micro networks.

These community vendors, micro providers or small water enterprises tailor solutions to geographic and demographic requirements. In most cases there is a private sector involvement as well as a risk capital component.

Publically funded solutions are not wide spread. Certainly a lack of existing service or infrastructure is the main driver. Successful organisations active (amongst many) are;

- Pure Water
- Water Health International
- Osram
- Solco International
- Asia Water Foundation

Revenue stream is usually captured by the sale of a “container volume” typically 20 litres. Pricing per litre will vary greatly and there is no general rule. SWE’s are dynamic should continue to flourish as micro finance enterprises continue to gain broader acceptance.

Kenya has become a hub for SWK projects. Currently, unregulated untreated water will sell for 20-50 Kenyan shillings (2-5 cents/20 litre container). Treated or “safe” water will typically be offered at 50 Kenyan shillings of 5 cents/20 litre container. [6]

TECHNOLOGY EVALUATION FOR KIOSKS

When assessing potable water needs then water kiosks and decentralised plants will almost certainly need a multiple stage design to address all the relevant source water contaminants. We know that many regions of Africa and India, as an example, will require TDS reduction due to elevated salt concentrations, fluoride and other dissolved species present in the feedwater.

These applications will require a multi –stage process treatment solution. Reverse Osmosis is an obvious candidate technology, but it is not without issues (brine production, energy consumption and maintenance to name a few)

Systems based on a robust design that can be duplicated in multiple locations will most likely deliver long term results. Sustainability in terms of energy consumption and chemicals is imperative. Whole of life cost (WOL) will be heavily influenced by operations consumables.

Decentralised community based plants that inefficiently consume energy; media, flocculants, etc cannot be long term viable options. Solutions that adopt biominicy and natural physio/chemical methods will prevail. Best technology “outcome” options for potable treatment that represent minimal environmental impact are as follows:

Technology Options	*Poor*	*Aver*	*Good*	*Exc*
Sand filtration	X			
Multimedia Filtration		X		
UV lamp			X	
Natural UV sunlight		X		
Ceramic membranes				X
Low pressure membrane				X
Ion exchange	X			
Reverse osmosis	X			
Coarse cartridge filter	X			
Fine cartridge filter	X			
Carbon filter/bed	X			
Flocculation/coagulation	X			
MIOX			X	
Chlorination			X	
Coarse screening	X			
Natural Zeolytes	X			
Biosand filter		X		

Figure 2: Comparison of potential established treatment technologies for potable water production

The Murdoch University School of Environmental Science (MUSES) undertook an independent three way evaluation of available technologies in 2004. The objective of the assessment by Wendy Green [7] was to verify technology options vs. performance and also determine if which of the options were most environmentally sound to alternative methods. (Laboratory tests over 2 months).

For verification, MUSES undertook laboratory examination of clay and algae turbidity removal as well as bacterial removal on 3 UF units. Control and membrane fault tests were also performed using deionised water and the bubble point test.

The Environmentally Sound Technology – Performance Assessment (EST-PA) was used to assess the amongst many options, UF, chlorine disinfection (by Calcium Hypochlorite) and others The EST-PA was still under development by the United Nations Environment Program. EST-PA proposed criteria and indicators were used with some suggested changes to analyse the technologies.

Murdoch University verified that UF membranes were found to be the most environmentally sound technology and suitable for low virus risk areas, whilst chlorine disinfection could be suitable but had higher environmental impacts. Other organisations , such as EAWAG have also undertaken independent assessment of gravity UF systems. Their findings are generally favourable and support the case for closer evaluation and consideration.

THE COST, VALUE AND SERVICE PROPOSITION

In the case of potable water kiosks and SWE's pricing like many commodities, is not primarily determined by the "treatment" cost but rather the overall investment and establishment costs on the facility. The overall project investment amortised for an "installation" can typically be as follows;

Item / breakdown	***Cost proportion %***
Land and building	50 - 75
Treatment equipment	10 -20
Consumables/energy	3 - 10
Labour	10 -25
Finance or loans	0 - 25
Local Marketing	0 - 10
Compliance & testing	0 – 5
Sundry costs	0 – 5

Figure 3: Typical proportional cost breakdown for the establishment of "informal" decentralised water kiosks

Small village installations range from as low as US $5000. However, it is not unusual for more substantial installations to cost upwards of USD $100,000. Some systems are supplying 20 litres of "safe" water per day for less than $1 USD PA.

SOME RECENT CASE STUDIES

The case studies presented here are typically small to medium size installations for 100- 1000 persons. Needless to say, the availability of a "safe" or non compromised source is a paramount consideration in the location of the kiosk or SWE. Also availability of the source water is a major decision factor. Some the typical installations are shown, but by no means comprehensive are;

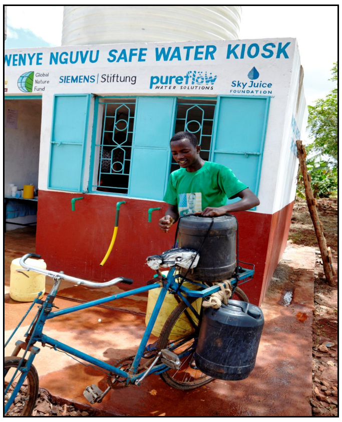

Figure 4: Safe Water Kiosks Africa: (Image:courtesy of Pure Flow Kenya)

Figure 5: Safe Water Aquahub installation:
(Image: courtesy of Siemens-Stifttung)

Figure 6: Low cost "Community Watertower" installation by Asia Water partners in India (cost = 50 cents/per/pa)

Figure 7: Retail water kiosk Kenya
(Image: courtesy of Pureflow Water Solutions, Kenya)

Figure 8: Low cost community Water Kiosk and vendor located in Kurail slum district of Bangladesh

Figure 9: Solco "Meeru Fen" Water Factory, Maldives Containerised RO plant including delivery service

Many installations use compact high volume membrane water filtration system designed for developing nations (specifically the Millennium Development Goals target No.7 outcomes) and disaster relief applications. The filtration barrier is a micro porous low pressure membrane that removes suspended solids, bacteria, helminths, and protozoa such as Giardia, Cryptosporidium, and some viruses.

This physical "disinfection" process when combined with optional chlorination (to ensure viruses are killed) produces safe drinking water from the majority of non-saline surface and ground waters.

REAL SOLUTIONS - AN OVERVIEW

There are many possible options to address the wider global issue. The issue is much broader than simply treatment and technology options. However, a cost effective and robust set of technology options is essential when addressing challenging feedwater conditions.

Skyhydrant™ is compact high volume membrane water filtration system designed for developing nations (specifically the Millennium Development Goals target No.7 outcomes) and disaster relief applications. The filtration barrier is a micro porous low pressure membrane that removes suspended solids, bacteria, helminths, and protozoa such as Giardia, Cryptosporidium, and limited virus rejection(typically up to LRV4).

This physical "disinfection" process when combined with optional chlorination (to ensure viruses are killed) produces safe drinking water from the majority of non-saline surface and ground waters.

Skyhydrant™ operates under as little as one metre gravity head. There is no pre-treatment, power or chemicals used in the treatment process. Operation and cleaning are simple and manual. The flexible design allows it to be operated in a range of configurations.It can be configured to operate in a pressure or suction mode. The overall "system" configuration is economical; compact, easy to transport and quick to deploy in the field. The filtration membrane is robust, cleanable and long lasting. The system offers a truly sustainable alternative for "safe" drinking water in poor communities.

The early gravity fed Skyjuice™ units worked well. The units were designed for single unit families. It became evident that a larger capacity gravity units were required for major relief work. Additional design reviews, development and experimentation began in mid 2004 to develop a larger capacity simple manual design.

Figure 10: Installation undertaken in Sri Lanka –IOM IDP camp installation (100,000 L/d capacity)

Figure 11 Crown Projects SkyStation solar site in Seenigama (20,000 L/d capacity)

The units are based on low pressure ultrafiltration (UF) membranes. It is well documented that both MF and UF were first applied for municipal drinking water treatment in the 1990's. The Skyjuice Foundation has now standardised on the use of low pressure ultrafiltration (UF). However MF membranes using low cost production and manual operation have also been used since 1997.

Skyjuice technology relies on spin agitation to regenerate flow or "backflush" i.e., drain down the module. Manual rotation around the vertical axis of the membrane element is undertaken to dislodge contaminants. There is no "reverse flow" backwash either using liquid or gas flows. A stabilised flux of approximately 15 L/hr/m^2 is achieved after the "long term biofouled condition" is established. This is referred to as the "normalised biofouled condition" for long term plant operation.(discussed later)

The core of the design is a proven and validated commercial municipal low pressure membrane. The housing and all wetted parts of the Skyhydrant™ units are constructed in roto-moulded food grade polyethylene suitable for SWE's. See examples in figures 4, 5 and 6 below.

Figures 12: A typical disaster relief "safe water kiosk" configurations supplied during the Haiti crisis (14 in total) also standard "package" for small water enterprises.

Figure 13 - Fast deployment & Erection OXFAM 4 station WaterTower kiosk system

Figure 14 - Safe Water Kiosk - WaterTower Flatpack Ready to ship weight 65 kgs, suitable for Small Water Enterprises (SWE's) core treatment system

TYPICAL SYSTEM PERFORMANCE

The Skyhydrant ™ Unit utilises a single MEMCOR® membrane sub-module within low pressure housing. Raw water flows from outside to inside via hollow fibre homogeneous Pvdf fibres. The system removes virtually all solids and bacteria and significantly reduces virus levels (LRV4 accreditation). Output is nominally 10,000 L/day.The normal configuration is for the units to operate as single installations or can be multiple unit systems arranged in parallel. They operate under constant head pressure. It is normal for capacity output for larger systems designed for 100,000 to 200,000 L/day output.

Number of sub-modules	1
Membrane Material	PvdF
Membrane Pore Size (micron)	0.1
Maximum Recommended Feed Particle size (micron)[1]	500
Maximum Recommended Feed Turbidity (NTU)[2]	500
Filtered Water Turbidity (NTU)	<0.1
Log Reduction Value for Particles 2-5 µm (LRV)	>4
filtration Operating Mode	Pressure and/or Suction
Minimum Recommended Differential Pressure (metres)	0.5
Maximum Recommended Differential Pressure (metres)	4.0
Nominal capacity (litres per hour)	400min (Max1000

Figure 15: Technical specification of Skyhydrant™

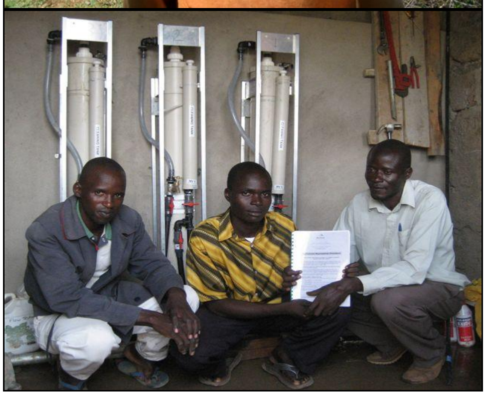

Figure 16: Three images showing the Kenya "Safe Water Kiosk" project at Obambo-Kadenge Village. This installation includes wind power and three Skyhydrant ™ units.

Flowrate is controlled manually. Chlorine addition can occur manually, usually downstream and generally in a batch operating sequence depending on site constraints. The effectiveness of the gravity UF system design is based on the manual agitation cleaning process.

As outlined, this is undertaken via the manual rotation of the membrane element in situ, followed by a gravity drain down of the filter housing. A quick and simple membrane wash sequence is carried out manually by the operator.

The "agitation or spin cycle" duration is approximately 90 seconds and generally occurs every 24 hours (reduced 4-8 hours under high turbidity and solids conditions, say >100 NTU). It can be extended to once every 24 hours depending on raw water turbidity and flowrate. .

The "drain down" water from the manual spin/agitation cycle can be disposed of by land soakage or return downstream to the source water. The volume is usually approx 7 litres every 4- 8 hours. This is considered very manageable. Despite very high turbidity feed water (>300 NTU) the "drain down" water is non toxic. There are no chemicals, flocculants or polymers used in the process even with very poor feed water quality.

Once the system has been established then the flux rate (output) will normalise. The baseline flow will stabilise at the "normalised biolfouled flux" (NBF). The NBF phenomenon was first documented on gravity (low TMP) UF conditions in 2003 [8].

The stabilised flow will depend on the specific head and feed water conditions, but is typically 15-20 $l/hr/m^2$. Typical Skyhydrant ™ flow rates and maintenance under NBF conditions are categorised below :

CONDITION	FLOW RATE (L/HR)	SPIN CYCLES (PERIOD BETWEEN)	CIP SOAK (DURATION)
LOW SOLIDS < 20 MG/L < 10 NTU	800 -1000 HQ GROUND WATER 750 -900 AVERAGE GROUND WATER 600 -800 SURFACE WATER	7 DAYS TYPICALLY 8 HOURS	2-4 HOURS
MEDIUM SOLIDS 20-50 MG/L 10-50 NTU	500 -700	6-8 HOURS	4-8 HOURS
HIGH SOLIDS 50-150 MG/L 50-100 NTU	400 - 600	2-4 HOURS	8 HOURS MIN
EXTREME CONDITIONS 150-500 MG/L 100-500NTU (ALGAE ?)	250 - 400	30 MINS TO 2 HOURS	8 HOURS MIN
INORGANICS FOULING	350 - 600	6-8 HOURS	2-4 HOURS (CITRIC OR SULPHURIC)

Figure 17 - Typical performance of single Skyhydrant TM unit under various feed water conditions

POTENTIAL FAILURE MODES

Failure is always a possibility if users become relaxed or sloppy. Manual systems do require active intervention and cleaning. Some general modes of failure have included the following:

1) Long term inorganic fouling by iron and manganese – corrected and recovered by acid clean (citric acid – local supply)
2) Faulty manual valves - rare, but units are supplied with 4 spare manual valves as backup in case of failure.
3) Low flow - usually lack of cleaning and no log sheets/records and numerous operators not "taking operating ownership" of the unit or installation
4) Periodic high microbiological readings – again, this is due to lack of cleaning and maintenance or hoses in contact with the ground (cross contamination)

A simple membrane chemical cleaning sequence (CIP - Clean in Place) is periodically required to remove residual fouling that is not removed by the wash sequence and to limit long term internal bio-growth on hoses, fittings etc . The frequency of cleaning is application specific, but is generally weekly.

Often it is asked "what do we do if the "drain down is toxic or contains arsenic"?, as an example. It is prudent to undertake a thorough site analysis of potential source. This technology only concentrates feed water. It does not add, precipitate and coagulate feed water. If pH correction or oxidation is needed, then normal disposal options should be evaluated, as per any treatment technology option.

WHAT ARE VIABLE OPERATING MODELS FOR DECENTRALISED KIOSKS

The Skyjuice foundation has been directly and indirectly involved in approximately 10 water kiosk projects. The delivery and implementation model varies widely. The largest cluster of projects is currently in Kenya. It is still early days to determine what the most viable long term model. There are definitely obstacles and hurdles to be overcome if a sustainable, self funding SWE is to a long viable proposition. Different SWE "value chain" models have included;

a) Direct community ownership & operation
b) Ownership as part of public assets
c) Independent water vendor
d) Hybrid "shared" development with a dedicated vendor and "investment"
e) Donor sponsored kiosk with community sponsored vendor/operator.

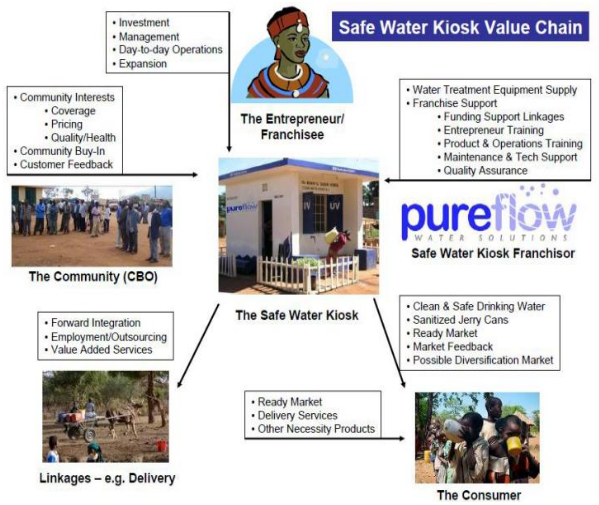

Figure 18 - Typical Safe Water Kiosk "Value Chain"

WHAT ARE THE DRIVERS FOR "SMALL COMMUNITY" AND DECENTRALISED WATER SOLUTIONS?

It is Interesting to note that authorities in China say there is insufficient fresh water in that country to support the western "flush & forget" infrastructure. Independent water kiosks and sanitation kiosks need to be critically evaluated due to the following emerging drivers;

- It is clear that a major "demand" bottleneck will be peri-urban environments in India, China and Africa. We need to address high density cluster systems sooner rather than later to meet urgent aspirational requirements

- Whole of life cost can be up to half the cost of conventional infrastructure.

- Little on no chemicals and only semi - annual service required to maintain system operations and ongoing operator support.

- They can be co-located into existing community "kiosk" hubs reducing operational costs, ie hybrid energy/water SWE or water sanitation SWE. This is already occurring in Kenya.

STRATEGIC INFRASTRUCTURE CONSIDERATIONS FOR SMALL NETWORKS

- They take the cost out of non value adding transport (i.e. dead assets) and put it into treatment solutions.

- The quality and reliability of the treated water allows it to be used for all non potable applications (potentially a 50% reduction in potable demand) with significant impact on water infrastructure and headworks.

- Avoids system externality inefficiencies such as water theft, distribution system maintenance costs.

- The local community say, 500-5000 persons takes ownership and responsibility for their welfare. Decentralised cluster systems are best deployed in periurban environments. The concept of a "cluster" design essentially adopts a "local ownership" model.

CONCLUSIONS, COSTS AND THE FUTURE

In summary, we are witnessing advancements and innovations in "enabling" technologies". This has lead to a plethora on "new" treatment systems in the developing world. Cost implications are promising. Safe affordable potable water at realistic volumes is now technically feasible but economic issues and urgency means we need to consider the following compelling drivers:

- 80% of the capital and most of the operating cost of centralised systems is invested in pipes, pumping and their service as distinct from treatment - transport is often a non value adding investment component.
- There is an urgent need to meet BOP aspirations and immediate needs and only decentralised can realistically achieve short term meaningful outcomes.
- Large centralised networks and systems are in many instances not environmentally sustainable. (cost and scale)
- New urban developments require large upfront infrastructure costs – Clustered or decentralised water treatment is incremental and more manageable
- The funding is simply not available or in place to meet MDG's using large capital intensive centralised solutions
- They also delay potential urban development due to multi donor facilitation and long term funding commitments.
- Centralised systems discourage individual environmental responsibility – convenient but easy to leave "tap running" of "flush it down the toilet".(in the case of sanitation)

There are existing low cost potable water cluster solutions that have been developed for immediate disaster deployment as well as medium term requirements. Currently, new players are emerging and the number of water kiosk projects, mobile water vendors; SWE's and community based water systems are steadily increasing. Each has a common theme being "decentralised treatment" of "kiosk solutions". The most innovative project provider is probably Pure Flow of Kenya, but there are many capable proponents.

Community based water vendors and entrepreneurs are viable. The solution and model is more complex than treatment and most involve a multi level commitment that includes validation, testing and hygiene reinforcement as well community interaction. The vendors are equally responsible to ensure water is collected in safe, clean containers. This is a big issue.

The opportunities for new paradigm solutions make for a compelling economic supposition. That assertion is that the Millennium Development Goals should be affordable and decentralised systems are practical. Technology is not a magic bullet. Communal supply based on poor quality water is the common scenario and flexible roust SWE's should find a niche.

Kiosk style plants for 3000-5000 people are now reality for less than US$10.00 per person per annum. These decentralised potable water solutions and kiosk concepts essentially means we have no reason to ignore the affordability of pure safe, sustainable water for all citizens of the world. There may just be the critical affordable technologies to assist developing nations to meet the multi facet objective of providing safe pure drinking water in a realistic and pragmatic manner.

BOP water consumers for water, energy and mobility will require cost effective and robust solutions. Those customers exist. A global ethical initiative to service our fellow citizens and provide them with basic dignity must surely rate as and immediate and overdue obligation. Now is the time to act. Technology is only part of the answer.

Note: The Skyjuice Foundation is a registered, independent, non-profit incorporated charity based in Australia. It is NOT a commercial organization.

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