Sunlabob Drinking Water System

Making drinking water in remote villages safe, reliable, sustainable and affordable.

Sunlabob Project

Situation

Clean drinking water is a basic human need, and its availability is a critical factor for health and consequently development. By reducing avoidable water borne diseases such as diarrhoea and cholera and the suffering inherent in these, people are more able to contribute to their community, and further development becomes possible.

This important issue has not been adequately addressed in Laos. It is estimated by WHO (2004) that 57% of the Lao population in remote areas is without access, or have inadequate access, to clean drinking water. Water is drunk directly from rivers and streams without being cleaned, or it is collected and boiled, which can be time consuming and damaging to the environment.

The equipment and technical knowledge to improve water purification techniques are currently not available in rural areas of Laos. These areas do not have access to current technologies due to their remoteness, and due to the significant capital costs of new technologies that Lao villagers cannot afford.

Sunlabob has a proven track record in introducing new solutions to remote Lao areas, as well as the infrastructure and operational network of franchises in rural areas to provide long-term training and sustainability. Sunlabob intends to put its operational assets to work on the challenge of making drinking water available on a sustained basis in remote villages of Laos.

Drinking water must be:

- of top hygienic standards
- reliably available on a sustained basis, and
- affordable for 90% of rural households, ie. as cheap as possible.

Conventional solutions (and their problems)

By far the most frequent solutions for improved drinking water in rural areas so far have been a) sealed communal wells with taps, often operated by hand pumps, and b) piped systems.

While these have often been highly effective in improving availability and hygiene of drinking water, they have their drawbacks:

a) Communal wells with hand pumps

These are boreholes or dug wells with a sealed top that does not allow dirt or spilled water to contaminate the well. Usually a hand pump at the top allows to draw the water for filling buckets or canisters for carrying home.

Drawbacks: The hygiene of the water is only as good as the hygiene of the bucket or canister. Open water can become contaminated while carrying home. Poorly managed wells can become contaminated and are then very difficult to clean and bring back up to good quality water.

b) Piped systems

This involves the tapping of a source, sometimes with filtering, then storage in a series of tanks, pumping in flat areas, then distribution through a network of pipes installed throughout the village.
Drawbacks: The hygiene is only as good as the source of water and the hygiene of the tanks and the pipes. Tanks particularly are a regular problem. Wastage in leaking taps and in the pipe network in general is a persistent problem. Furthermore piped systems are uneconomic for widely spread out villages or unfeasible in difficult terrain.

Drawbacks common to both these usual solutions are:
Reaction to problems instead of prevention of problems:
These systems are built to operate until a problem occurs, at which time corrective action is taken – provided the village has managed to save enough and has the money available to take care of the problem. By the time corrective action must be taken, the hygiene of the water is mostly already compromised.

Maintenance depends on reliable community institutions:
Such institutions must have the competence to collect and transparently manage the required money. Raising the communal funds for reliable maintenance is a recurrent headache. Furthermore the required "social capital" is usually underestimated: The need to organize and control a public body trusted by all villagers to take care of the systems and transparently manage the funds earmarked for the drinking water systems.

It is because of these drawbacks of piped systems that bottled water for drinking is spreading even in areas that have good access to piped water.

However, piped systems provide important benefits, particularly for bathing, washing, kitchen gardening and animal husbandry at home. Managing a piped system that provides clean water below drinking water standards is much easier and cheaper. The ideal is piped water for household use and bottled water for drinking (or the equivalent filter technology in each household).

New solution for villages

Sunlabob has envisaged a system where bottled water can be produced safely and sustainably in villages. This system combines solar energy, active filtration, UV and ozone sterilization and localized chlorine production with Sunlabobs expertise in introducing technical solutions to villagers and enabling the establishment of local small enterprise. Sunlabob draws on its experience in establishing a network of village entrepreneurs for solar rental services.

Sunlabob will sell water purification units to Lao villages, which can be used to pump, clean and sterilize water to safe drinking water quality. Sunlabob will also sell water bottling facilities, including recyclable plastic PE bottles (20 Litres) and equipment to locally produce chlorine that is used to disinfect bottles after they are returned for refilling. The unit will be owned by the village community which may get public grants from government or donor agencies to purchase the unit along with the servicing package.
Small enterpreneurs shall then rent the unit from the village authority. This entrepreneur will instantly have a vested interest in maintaining and operating this system as his income will be derived from the success of his operation. The entrepreneur will sell the water at a price that enables him to provide a salary for himself and any employees and to pay all maintenance costs, including the replacement of the system at the end of its lifetime.
This entrepreneur will receive initial technical and operational training from Sunlabob, as well as ongoing support, water quality checks and provision of replacement components through Sunlabob's established network in all provinces of Lao PDR.. The village committee will also receive training in the effective management of this system. This training will be funded by the donor as a servicing package.
If, after this training, the entrepreneur cannot adequately manage the system, then the village committee will cancel his lease of the system and find another entrepreneur. Sunlabob will be given authority by the donor to remove the system from the village should the village committee be unable to administer it.

Advantages of this approach over conventional solutions are:

1. Sustainability of quality is achieved by the combination of the incentive of small enterprise and Sunlabob's technical and operational support. The system can also be financially sustained through effective management – ensuring that the money provided by the donor is wisely invested.

2. Proactive quality control: There is an intrinsic interest to continuously maintain quality – as opposed to reacting when a problem arises. The entrepreneurs have an interest to ensure that each bottle of water achieves top quality standards even before it is sold to a household.

Drawbacks of this approach may be:

1. The poorest households in the villages may want to save costs and therefore avoid paying for bottled water. Village level welfare institutions will have to emerge that take care of the poorest 10% of households.
2. Dependence on supply chains and technology that can only be sustained by expertise from outside the village. This needs to be countered by effective and reliable operations between Sunlabob and village technicians operating the systems.
3. The notion that water cannot be sold because it is a right of every human to have clean drinking water. This notion is not contested here. But it must be clear that cleaning water costs, whether this is done by the public or by private enterprises. Even boiling water at home costs: The time used to collect the firewood, and the ensuing environmental degradation. The fee is not for the water, but for the services brought to the water to make it safe for drinking.

Business proposal

The niche to be developed is this:
Make 20 Litre sealed bottles of high standard drinking water available in the remote villages at prices affordable to 90% of the households.

The service package to achieve this is aimed at village entrepreneurs. This package comprises:

1. Pump, filters and UV devices to produce clear sterilized water
2. Equipment to produce chlorine solution for rinsing before filling
3. Solar power equipment to operate the machinery
4. Refillable 20 Litre bottles
5. Quality seals and labels
6. Regular trainings with Sunlabob for maintaining quality and implementing technical advances (part of agreement with donor)
7. Operational, financial and technical services from Sunlabob
8. Regular quality monitoring and water testing (provided by Sunlabob in cooperation with the ministry of health)

The immediate expected market for this package is villages in rural and remote areas of Laos.

A. Remote villages with difficult access, where piped drinking water systems will not be established in the foreseeable future.
B. Villages with dispersed households spread over difficult terrain, where piped systems are expensive to establish and maintain.
C. Villages with persistent problems of achieving safe drinking water standards in their piped systems.

These communities have the combined disadvantages of inaccessibility to drinking water, and very low income. Thus they have an urgent need for inexpensive clean drinking water, which Sunlabob can meet through its operational concept. This market is large, as it comprises 57% of the Lao population distributed throughout the country.

With success, there is potential for this concept to also spread to other countries. Partners of Sunlabob in SE-Asia, in Africa and Latin America have already shown interest.

Funding

Funding will be as follows:

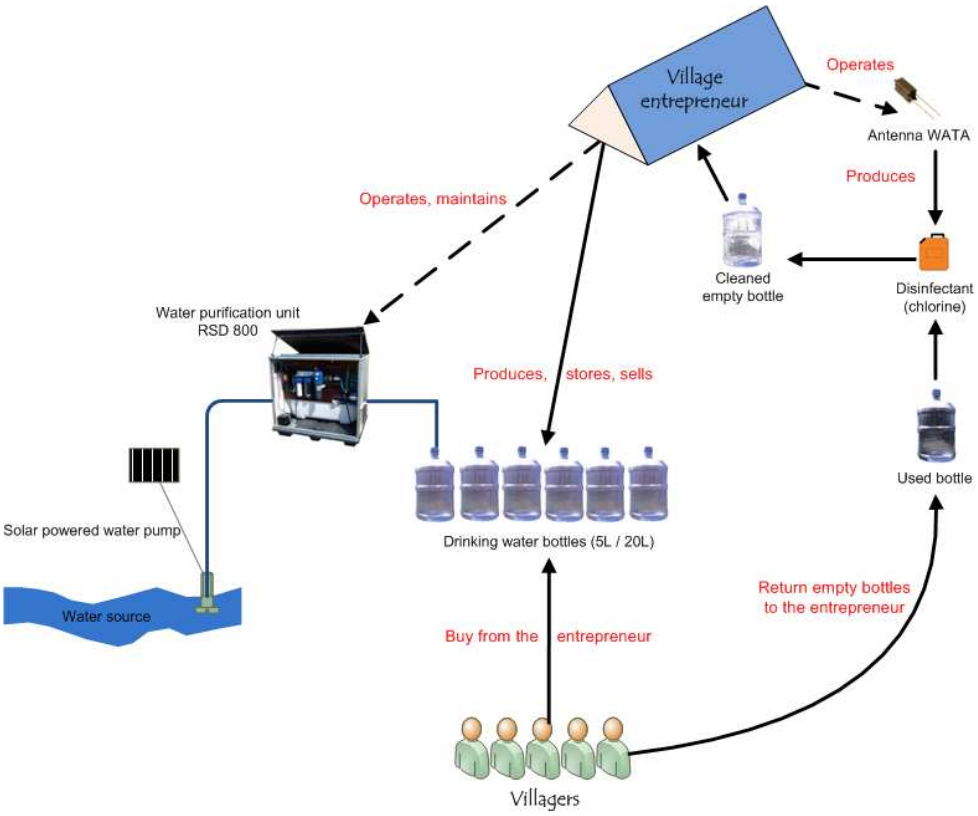
1. Funding agencies (eg. donors) provide grants to identified villages to be able to purchase the package.
2. The village buys the package from Sunlabob (including the servicing and training arrangements) and then owns the equipment. The village water committee manages this asset on behalf of the village community.
3. The village water committee rents out the equipment to a Sunlabob-trained small entrepreneur in the village, who will operate it as his/her own enterprise. Trainings for the small entrepreneur are part of the package.

4. The rents are paid to the water committee, which opens a water fund to save for replacements, and pay for repairs and servicing. The water committee may entrust Sunlabob to directly take care of these transactions on its behalf and once a year clear the financial situation with the water committee.

Sunlabob believes the commercial relationship between the small village water entrepreneur and the benefiting households in the village will achieve sustainability if and when Sunlabob can stay in contact through the servicing agreements.

Technology

The water treatment system that Sunlabob is proposing is designed to make water potable through solar powered ultraviolet and ozone water purification. The following diagram shows the connection between all the system components:



Water pumps:

Sunlabob will install solar powered water pumps to pump the raw water from the water source to the RSD unit (depending on the village's needs). These pumps will vary in size depending upon the head of the water source.

Sunlabob has considerable experience and expertise in installing these pumps, as we have installed more than 80 solar powered water pumps throughout Laos and Cambodia. Sunlabob is able to provide comprehensive training on the use and maintenance of these pumps to village technicians to accompany training received on water purification.

<u>Specifications and performance</u>
Depending on location and required throughput

<u>Maintenance and operational issues</u>
Standard operational procedures of Sunlabob-installed pumps.

Preliminary filtration

Sterilization of water through UV light can only be achieved with water that has a low level of turbidity. The RSD UV/ozone water purification system has inbuilt filters that can take care of these turbidity problems, Filters are also available that remove taste and odour, as well as certain chemicals such as arsenic and nitrate.

Specifications and performance
Depends upon source water quality

Maintenance and operational issues
Regular replacement of filters, which must be sourced externally

UV-treatment with RSD 800:

Our World Pure Water's tested and well established RSD technology will be used (http://www.rsdsolar.de/UV/UVC1.html).

A combination of UV- and ozone treatment will be used.
UV treatment of water inactivates pathogenic microorganisms (the RSD800 unit inactivates 100% of these microorganisms). These include the microorganisms that cause E-coli, cholera, typhoid, dysentery and hepatitis (source: SODIS).
Ozone treatment is also able to remove the same microorganisms, as well as organic and inorganic material, iron, manganese and sulphur. This is secondly used for the disinfection of the pipelines between treatment and the delivery nozzle. By using these treatment methods together, water quality is guaranteed to be of the highest quality.

Specifications and performance:
The RSD UV/Ozone treatment system can provide up to 5000L per day. This is sufficient for the daily needs of 1250 people or 250 households. It can easily be connected to a solar system through an inverter, or alternatively connected to the grid when this is an option.

Maintenance and operational issues
The RSD unit incorporates two UV lamps, one which is used for flow sterilisation and one which is used for Ozone production. The lifetime of both of these UV lamps is 8000 hours. The device is monitored by a sensor. Once the UV device is no longer effective at sterilising the water, an alarm will sound. A counter is also provided so the entrepreneur can track how many hours he has used the lamps for.

The RSD800 technology is simple to operate, and can be easily maintained by a village technician provided they have ready access to replacement components (except for the ozone and any major maintenance on the UV treatment system, which should be replaced by a RSD qualified technician). Sunlabob can provide this service.

Chlorination with WATA from Antenna:

Sunlabob will use the Antenna WATA technology developed by Antenna Technologies: (http://www.antenna.ch).

Antenna's handheld chlorination device uses electrolysis to create a chlorine solution. Chlorine is a powerful disinfectant that inactivates pathogens. It can be used to disinfect drinking water, but measuring the necessary chlorine/water ratio requires precision. It is much simpler to create a chlorine solution that can be used to disinfect surfaces and materials, such as water bottles. For this reason the produced chlorine solution will not be added to the drinking water, but be used to rinse the returning bottles before filling again with sterilized water from the RSD water treatment system.

Specifications and performance:
The device needs to be connected to 12 Volt DC electricity.
From one litre of clear water with 25gr of solved table salt (NaCl) it will produce 1 litre of 6g/L chlorine solution within one hour.

Maintenance and operational issues

Concentrated chlorine solution can be dangerous if it is inhaled, drunk or if it comes into contact with skin or eyes. The chlorination process also creates hydrogen, which is a flammable gas, so the procedure needs to be carried out in a ventiliated room. These risks are taken care of by ensuring that only correctly trained village entrepreneurs with correct safety equipment (glasses and gloves, opaque bottles, etc) handle the chlorine solutions.

Maintenance needs of the device are limited - the chlorinator simply needs to be washed after each use.

The chlorine/water ratio for a disinfectant is much higher than that for drinking water. It is used for rinsing the bottles to make them safe, not for sterilizing the water that goes in for drinking. Furthermore the more concentrated solutions may be used by trained personnel in village health posts etc, for disinfecting surfaces.

Antenna chlorination devices have experienced no failures during the last six years of production.

Solar power

The pumps, the UV lights and the chlorination device all require electricity to operate. Sunlabob will follow its well established procedures for installing and operating the power systems through arrangements with the franchised village entrepreneurs. In most cases this will be solar. However, in areas that already have grid power more economical solutions will also be implemented

Specifications and performance:

The size of the solar system should be determined by the site conditions, but is typically between 100Wp and 150Wp.

Maintenance and operational issues:

According to arrangements between franchisees and Sunlabob already standardized for solar equipment.

Bottles (20 litres)

This is a well-known and tested technology with established supply chains in Laos.

Specifications and performance:

20 Litre bottles of Polyethylene.

Maintenance and operational issues

The bottles will be sealed with plastic seals, applied by pressure and readily available in Vientiane. This ensures that water can only be sold by the village entrepreneur, and customers can be assured of receiving clean, potable water.
Incentives will be introduced to encourage villagers to return their seal when they receive more water, in order that the seals can be returned to Vientiane for recycling.

Data tracker

Data trackers are crucial in monitoring system performance, especially when a system must be monitored frequently. Sunlabob has data tracking systems (such as within charge controllers) in all of our installations, such as in our solar systems and our hybrid village grids, to track energy inputs and output. A flow meter will also be incorporated into the water purification system that will be used to monitor important aspects of the system such as water pumping characteristics (time, amount etc.)

Specifications and performance

Still to be defined, depending on system design and operational performances

Maintenance and operational issues

n.a

Investments

Equipment

(gate price Sunlabob, ie. including import tax, assembly and testing at Sunlabob, packaging for transport to village, etc).

1. Solar power pack to operate pump, RSD system and Antenna WATA. (Note: It is assumed that a village entrepreneur will use a large solar array for multiple purposes, ie. also for charging batteries of lamps, etc. In such a case the costs for the power pack can be shared with other applications).
2. Pump
3. RSD UV/Ozone water purification system
4. Data-Tracker Control Unit and its Software, Flow Meter
5. Antenna WATA
6. 500 twenty litre bottles (to account for daily amount produced and replacements)
7. Water testing equipment
8. Safety equipment for handling chlorine solutions
9. Materials for housings of equipment on site.

Installation:

10. Transport
11. Wages and expenses for installation crew

Trainings

12. Initial training of village entrepreneurs (fees for trainers, transport, daily allowances, etc).

Operational cost factors

1. Salt
2. Official water testing

Replacement component costs

3. Batteries
4. RSD filters
5. Drinking water pump (RSD800)
6. Raw water pump
7. Bottles
8. Safety equipment

Franchise costs

9. Quality monitoring (e.g water testing)
10. Trainings
11. Seals

Operational Overheads

12. Secretarial
13. Marketing
14. Coaching

Contractual arrangements between Sunlabob and…

Our World Pure Water GmbH (guaranteed sales agreement):
On inclusion of RSD800 in the comprehensive package

Antenna (guaranteed sales agreement):
On inclusion of Antenna WATA in the comprehensive package

Suppliers of seals

Donors and village entrepeneurs: Agreement with Sunlabob for maintenance

Ministry of Health: For regular official testing of water and providing certificate of approval.

Local village and district authorities as required

Supply chains

Power: Providers of solar equipment known to Sunlabob
UV/ozone sterilization: Our World Pure Water GmbH
Chlorination: Antenna WATA
Salt: Local
Bottles: Local companies
Seals: Local companies

Equity issues

The target is to achieve a cost covering price for the water that at least 90% of households in an average village will be willing to pay.

The remaining 10% of course also have a right to clean drinking water even if they cannot afford it. This right must be ensured through welfare measures under the control of the public bodies of the village, ie. the village authority. They must decide who is eligible for getting water at a cheaper rate or for free.

For this purpose 10% must be added to the cost-covering price for a bottle of water. The village entrepreneur will provide free bottles to the households designated as eligible by the village authorities.