

Developing a Toolkit to Improve Water Quality  
At Blacksands:

# A Demonstration of Solar Water Pasteurization

**Project Proposal  
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"The human right to water entitles everyone to sufficient, safe, acceptable, physically accessible and affordable water for personal and domestic uses" General Comment No. 15 (2002): The Right to Water.

- UN Declares 2005-2015 "Water for Life" as the International Decade for Action and set's the world agenda on a greater focus on water-related issues.

"We shall not finally defeat AIDS, tuberculosis, malaria, or any of the other infectious diseases that plague the developing world until we have also won the battle for safe drinking water, sanitation and basic health care."

Kofi Annan, United Nations Secretary-General

Eight Millennium Development Goals were agreed by the Member States of the United Nations at the Millennium Summit in 2000. The targets state that the proportion of people worldwide not having access to an improved water source, and the proportion of people worldwide not having access to adequate sanitation facilities, should be halved between the baseline year of 1990 and 2015.

## **Introduction**

There is nothing more dear to us than water. Human life (as well as all animal and plant life on the planet) is dependant on water for life. We can exist without many things if we have to: we can be deprived of comfort, shelter, clothing, even food for a while; but we cannot be deprived of water and survive for more than a few days.

Vanuatu is fortunate in that much of the country has plentiful springs, streams, and rivers that provide drinking water for the rural population. Port Vila, the capitol of Vanuatu, is even luckier because Unelco, the water utility provider, provides piped water to most businesses and residences in town. However, just outside of town there is a settlement called Blacksands where there are severe water supply problems.

## **The Problem at Blacksands**

Blacksands is a squatter community located on the outskirts of Port Vila. It is a densely populated area of more than four thousand people. People in Blacksands come from all over Vanuatu. Blacksands is a marginalized community of mostly low income households.

There are no municipal water or sanitation services available in Blacksands. People in Blacksands are dependant on water from the Tagabe River or water from open boreholes to supply all of their water needs. Blacksands is situated at the mouth of the Tagabe River making it vulnerable to all upstream pollution. By the time the Tagabe River reaches Blacksands it is very polluted. The groundwater from the boreholes is also heavily contaminated

with organic pollutants. Most households' sanitation needs are met by pit toilets. As the water table is not very deep, the effluent from these toilets seeps readily into the groundwater making this water unfit to drink by any standards.

As a result, residents of Blacksands are vulnerable to a wide variety of water based disorders, including:

- **Waterborne diseases.** These are diseases which are the direct result of consuming contaminated water, such as diarrhea.
- **Water-washed diseases.** These are the effect of inadequate quantities of water for personal hygiene and/or the use of un-hygienic practices which contaminate water and cause disease. Without enough water, skin and eye infections are easily spread, as are the faecal-oral diseases.
- **Water based diseases and water-related vector-borne diseases.** These diseases are caused by standing water which provides an essential habitat for mosquitoes and other parasitic hosts that cause human diseases. Malaria is the obvious example of this type of disease.

## **Project Goals and Objectives**

The primary objective of this project is to demonstrate ways to improve water quality in the Blacksands Area through solar water pasteurization. Other objectives include:

- To raise awareness of the importance of a safe, clean water supply.
- To raise awareness of the health hazards/risks of using unclean water.
- To empower people to manage and their own water supply.
- The sustainable provision of an improved water supply at the community level and at the household level.

## **Purpose**

- To compliment global water agenda (MDG, UN, WHO.)
- To improve the quality of life for a marginalized community.
- To decrease the public health risks associated with using an unsafe drinking water supply and to decrease the corresponding social costs.

## **Description of Solar Water Pasteurization**

It is not necessary to boil water to make it safe to drink. If water is heated to 65° C for about 6 minutes, or to a higher temperature for a shorter time, all the germs, viruses, and parasites that cause disease in humans are killed, including cholera and hepatitis A and B. This process is called pasteurization and its use for milk is well known though milk requires slightly different time-temperature combinations.

### Pasteurization Defined

- Pasteurization is the process of disinfecting food or liquids by heat or radiation. Disinfection means the destruction of disease-causing microorganisms.
- The word "Pasteurization" was named after the French doctor Louis Pasteur, the father of modern medicine.
- In 1864, Pasteur demonstrated that wine diseases are caused by micro-organisms that can be killed by heating the wine to 55°C for several minutes.
- Applied to beer and milk, this process, called "pasteurization", soon came into use throughout the world.
- Pasteur's research proved that sufficiently heating a substance destroys all disease causing germs. Pasteurization has been accepted as completely safe for more than 135 years!
- Today, throughout the world, beverages such as milk, fruit juice, beer and wine are disinfected through pasteurization. Consumers are familiar with and trust the process of pasteurization.
- Pasteurization is a function of time and temperature. If heat is applied for a long period of time, disinfection will occur at a lower temperature. At higher temperatures, disinfection occurs in a shorter period of time.

### Solar Water Pasteurization

- Unclean water can be treated with the time-honored technique of pasteurization to disinfect water that is microbiologically contaminated.
- Laboratory testing of solar water pasteurization confirms an effectiveness of 99.999% in disinfecting water that contains disease-causing micro-organisms, including bacteria, viruses, worms and protozoa.
- The effectiveness of solar water pasteurization is superior to treating with chlorine, slow sand filtration, ceramic filters, roughing filters, and boiling.

### Advantages of Solar Water Pasteurization

- 99.999% Effective in destroying waterborne pathogens.
- Destroys disease-causing viruses, bacteria, protozoa, spores and worms.
- Uses only the heat of the sun; does not require electricity, fossil fuels, fire wood, chemicals or water pressure.
- Prevents air pollution, ozone damage, deforestation, and soil erosion.
- Superior alternative to chlorine treatment, which is rated "poor" at destroying worms & protozoa, may be bad for one's health, and leaves a chemical taste in the water.
- Low maintenance.

## Project Activities

Vanuatu Renewable Energy and Power Association, together with Blacksands community members, will install a flow-through solar water pasteurization unit in Blacksands. This unit will pasteurize 1000 liters of water/day on sunny days. Feed water for the pasteurizer will be gravity fed from an elevated tank. A solar powered pump will fill the tank. Pasteurized water will flow from the pasteurizer to a suitably sized water storage tank. The project will also construct a rain catchment shelter so that rainwater can be harvested and used to supplement the pasteurized water. In this way, the system should provide adequate drinking water regardless of weather conditions.

Vanuatu Renewable Energy and Power Association will also conduct a workshop which will discuss the following issues:

- Different Strategies for Solar Water Pasteurization. There are several different ways to solar pasteurize water. Some of these can be done at the household level. Most can be easily made from inexpensive materials or purchased at reasonable prices. These include:
  - Solar Cookers. Solar box cookers and solar panel cookers can be used to pasteurize water at the household level. Their use and construction will be detailed at this workshop.
  - Solar Puddle. A solar puddle is a device that can easily be made of inexpensive materials. A solar puddle can pasteurize more water than a solar cooker. Its construction and use will also be detailed at this workshop.
  - Other Devices. Other devices such as the AquaPak, Family Water Pasteurizer, and some commercially available solar cookers and accessories will be demonstrated at the workshop.
- Water Pasteurization Indicator. A Water Pasteurization Indicator, or WAPI, is an important device in that it tells us when water is safely pasteurized. A WAPI should be used with all of the devices listed above.
- The relationship between Water, Sanitation, and Health. Water, sanitation, and health are closely inter-related. We cannot look at one, such as water, without considering the other two.
- Strategies for Managing Water. Careful consideration must be given to forming a community "water utility" and managing the community water supply.

VANREPA will produce a "Community Guide to Solar Water Pasteurization" in Bislama and English. This manual will detail key elements of the workshop as well as serving as a user's manual for the flow through pasteurization unit. VANREPA will make regular follow-up visits to Blacksands for one year to help ensure that this project becomes a well-running community institution.

## **Sustainability**

The solar pasteurization of water requires no fuel, only sunshine. Therefore there are no ongoing fuel costs. There is only one moving part in the flow through pasteurizer, the thermal control valve, which has been tested beyond a million cycles. The only regular maintenance required is occasional filter cleaning. It is constructed of durable, high quality materials for a long life, greater than fifteen years. The household units have no moving parts and should therefore last for many years.

## **Multiplier Effect**

Not only is this project sustainable, it is very easy to replicate it in other communities in Vanuatu, such as in other parts of Blacksands and Etas. Therefore, it could have a major impact on a significant percentage of the population in a short period of time.

## **Beneficiaries**

The entire country will benefit from this project through education and awareness raising. In addition, a significant percentage of the Blacksands community will directly benefit from an improved drinking water supply.

## **Benefits to Women**

Providing her family with water for drinking and cooking is one of a woman's primary responsibilities in rural communities in Vanuatu. Therefore, providing a more reliable water supply will greatly improve the quality of women's lives.

# Pasteurization Project Budget

## Flow-through Pasteurizer

Pasteurization units and solar cookers	641,850 vatu
Overseas shipping	115,100 vatu
Installation Kit, including:	74,250 vatu
Copper tubing, bulkhead fittings, ball valves, compression fittings, check valve, hardware kit, pipe insulation, foil tape, Teflon tape, tubing cutter, hole saw	

## Tower

Steel	143,000 vatu
Cement	14,400 vatu

## Catchment Shelter

Iron roofing	74,295 vatu
Gutters	17,102 vatu
Timber	122,009 vatu
Fasteners	13,844 vatu
Cement	7,342 vatu

## Tanks

1 x 1100 liter poly (supply tank)	48,000 vatu
1 x 5000 gallon ferro-cement (storage tank)	270,250 vatu

## Solar Pumping System

Solar panels	120,000 vatu
Solar controller	19,400 vatu
Wires, fuses, and electrical fittings	18,500 vatu
Solar pump	53,900 vatu
Hoses and plumbing fittings	27,500 vatu
Filter holder and cartridge	34,300 vatu

Technical Support and Assistance	1,360,000 vatu
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Freight 65,000 vatu

Administrative Support 325,000 vatu

**TOTAL DONOR COSTS 3,565,042 vatu**

### In-kind Community Contributions

Land rights  
Sand  
Coral  
Labor