# Proposed reduction of preventable deaths in rural Indonesia through stormwater harvesting and wastewater treatment

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**ABSTRACT:** *Worldwide, what is responsible for killing the most children each year? Acute Respiratory Infection (2 million children). What is second? Diarrhoea (1.8 million children). This statistic does not include the additional 300,000 adults who also die from this preventable condition. Diarrhoea kills more children that malaria, HIV and measles combined (UNDP, 2006). "In most of the developing world, unclean water is a greater threat to human lives than violent conflict. Right now almost half the population of the developing world suffer from diseases because of dirty water and inadequate sanitation" (Peace Child International, 2006). While the Millennial Development Goals (MDG) and the United Nations provide an overarching view of the existing situations by country, the initial goal of this project is to investigating the specific existing conditions in rural Indonesia, especially Southern Kalimantan, and how they relate to the MDG (UNDP, 2003). This will in turn allow site specific proposals in partnership with the local communities that are culturally and financially feasible. They will then be designed and constructed in conjunction with community education. The preliminary proposal is to use stormwater harvesting to provide a clean water source in replacement of their current sources; seasonal wells, contaminated rivers and swamps. In conjunction is the proposal to eliminate their exposure to open sewage through simple septic systems. Through these processes, the goal is to decrease the preventable cases of sickness through increased access to clean up and decreased exposure to open sewage. This in turn will reduce the associated deaths due to diarrhoea (WHO/UNICEF, 2009). The project is still in the initial research and development stages as of March 2012 with the first project hoping to be undertaken by the end of 2012.*

**KEYWORDS:** Water, wastewater, rainwater, health.

**Figure 1:** Typical housing in rural Southern Kalimantan.

## 1 INTRODUCTION

### 1.1 Background

Of the 5 billion cases of diarrhoea in the world each year, 1.8 million children perish (UNDP 2006). Every year, at least 300 out of 1,000 Indonesians suffer from water-borne diseases, including cholera, dysentery, and typhoid fever, according to the Ministry of Health (Asian Development Bank, March 2006). Indonesia is only second in the world to India, relative to the number of people, consistently exposed to open sewer (66 million) (WHO/UNICEF, 2009). The percentage of Indonesia's population without sustainable access to an improved water source is 23% (UNDP, 2006). Note that an improved water source still may not be an acceptable water source. While this reality in Indonesia leads to many different consequences, one that is alarming is that within the economically poorest 20% of the population in Indonesia (in 2005), the mortality rate for children under 5 was over 10%. The average across the country was approx. 7% (UNDP, 2006). These statistics and outcomes are not unrelated. Diarrhoea usually originates from contaminated water and/or food. Open sewers is a common source for the contamination and spread of much disease and sickness. Access to clean water and sanitation can reduce the risk of a child dying by as much as 50% (UNDP, 2006).

### 1.2 Existing conditions

While the residents living in Banjarmasin and Banjarbaru, the larger cities of Southern Kalimantan, have greater access to clean water than most areas of Indonesia (35%), there has been no specific information from the rural areas.

The initial survey already undertaken in conjunction with the local authorities has identified 29 villages of greatest need in the area. The following information has been collected on these particular villages:

- The sources of drinking water vary depending on geographical location. These sources range from the river, wells, ponds/swamps, and a supply truck from the city water supplier. Typically each village has only one of these sources with some having multiple sources.
- The source for bathing is typically from the river with some villages using supply from wells and ponds/swamps.
- The source for washing clothes, etc is typically from the river with some villages using supply from wells and ponds/swamps.
- All human wastewater usually goes into the river untreated. There are some 'septic' tanks in the ponds/swamp directly adjacent to the houses although their functionality is minimal at best. They may actually be creating more of a long term problem though we have yet to investigate them in finer detail.

The typical treatment for any of this water (except from the truck) in each household is the application of an aluminium flocculent readily available (Tawas) and boiling for up to 10 minutes. The local authorities do not see this local treatment as a long term sustainable solution. Further onsite research consisting of interviews with community leaders and locals in the villages will be conducted to help determine solutions that will be culturally appropriate and constructed using local resources as much as possible. As this work is development focused as opposed to relief or rehabilitation, one goal is to construct these projects with a minimal investment from outside of their communities and government.

### 1.3 Limitations

The geographical dimensions to consider in this project are that villages are usually either on the river flood plains (certainly below the Q100 flood line and often below the Q5 flood line), in swamp areas or inland with limited access to groundwater. Access to these villages is usually by motorbike or boat with only a few accessible by a car or truck. This can make basic construction challenging and requires that we anticipate both local and river flooding scenarios to limit the possibility of further contamination from flood waters. Because of the remote locations, materials for construction will need to be utilised that are familiar to and easily available to the local people. This will help reduce the overall financial costs and allow infrastructure to be built that is feasible and ultimately sustainable and reproducible for the long term.

Understanding the culture will be critical to enabling 'buy in' from the entire community and not just the government leaders. Initial studies already show an underlying apprehension from the people about using rainwater although their reasoning changes from village to village. They believe that the river water is cleaner and better for them. We need to be careful not to make the assumption that the local people want clean water and their wastewater treated.

The community will need to be involved in the project from the beginning otherwise the infrastructure will rarely be used and quickly fall into disrepair. This has already been witnessed in one of the villages already surveyed.

A comprehensive public education program (based on anthropological studies and tailored to their culture) along with community commitment (contribution of finances, time, resources, etc.) will hopefully lay a strong foundation for the longevity and propagation of this project.

**Figure 2:** The close proximity of the bathing/washing area and the toilet.

**Figure 3:** Example of 'septic' tank – uncontained system with fish.

### 1.4 Assumptions

We are assuming or at least working towards these projects being cost neutral. This is a large assumption and something that is being assessed in the initial research and planning. The assumption has also been made that the rain water in Southern Kalimantan is acceptable for human consumption without further treatment. Initial research indicates a pH of the rain water to be 5.2 but this needs to be verified through further research. If this is in fact the case, an additive will need to be used to neutralise the pH value. The assumption is also being made that using rainwater, if not currently culturally acceptable, will be after anthropological studies and contextual education. While there are real obstacles and challenges to overcome, the primary focus of the project should not be lost.

### 1.5 Thesis

The purpose of this project is to reduce the number of preventable deaths, particularly of children, from diarrhoea and other waterborne diseases. This will

be done through eliminating exposure to untreated wastewater and increasing the availability to an uncontaminated water source.

## 2 METHODOLOGY

### 2.1 Materials and equipment used

The two major components being considered for success in the project are as follows:

#### *2.1.1 Uncontaminated water source*

Currently, locals use river water, local wells, swamps or trucked in water for consumption and domestic use. Because of contamination, financial costs and the long dry seasons, these options are not sustainable for the development of the wider community.

Most water sources, except for the larger rivers, are dry for at least some part, if not most of the dry season thus leaving the village with no water supply at all.

**Figure 4:** Access is difficult: transportation of construction materials is a challenge.

**Figure 5:** Typical housing in rural Southern Kalimantan, typically surround by swamp.

Through the utilisation of rain water harvesting, this project intends to overcome the current barriers to a consistent uncontaminated water source. The first step is to identify an impervious area that is acceptable from which to retrieve rainwater. An assessment of the roofs in the local villages will be conducted to see if they are feasible. If so, simple roof guttering can be attached to the roofs to collect the rainwater and direct it to a storage tank.

If the roofs are not adequate, an alternative solution will be designed such as constructing rainwater tanks with impervious roofs that will enable a suitable catchment area. These will all be designed to take into account the hydrology, costs and local resources, sustainability, reproducibility and functional practicalities.

Depending on the density of the housing within the villages, it is envisaged to have one tank service anywhere from 1 to 4 houses. Everything will be gravity fed and each house and will collect the rainwater directly from the tank. In very limited situations, the tanks may be connected into a household plumbing system (typically houses do not have plumbing systems). It is envisaged that the tanks will be above ground and large enough to store drinking water (at a minimum) over the dry season for each family it services. The specific design of this will evolve over time to take all aspects into consideration.

**Figure 6:** Previous project infrastructure sitting unused (reticulated river water).

### *2.1.2 Wastewater treatment*

Currently, human sewage is not treated and most of it is deposited directly into the closest water course, river, surrounding pond or swamp. For villages not located close to a river or swamp, the sewage usually goes straight into a hole in the ground that is typically not protected and quite often subject to flooding. As stated earlier, there are also some 'septic' tanks in numerous places that are basically ineffective from the initial research. Ideally, this project aims to treat the wastewater and remove the exposure to the village population. The initial thought is to utilise conventional single or two stage septic tank systems.

The local government is familiar with these contained systems and has encouraged the project to implement them as a long term sustainable solution in this area. Topography, local and river flooding along with the swamps and ponds in immediate proximity to the houses will be critical factors in the design solutions along with the other challenges such as maintenance.

## 3 CONCLUSIONS

While the project is still in the early stages, the initial research results along with the co-operation with the regional government lay a solid foundation. By utilising the technical engineering and anthropological experience of those committed to the project, along with the partnership from local knowledgeable and influential professionals, the challenges before the project are manageable. Our

**Figure 7:** Example of a storage tank.

goal to reduce the number of preventable deaths, particularly of children, from diarrhoea and other waterborne diseases through eliminating exposure to untreated wastewater and increasing the availability to an uncontaminated water source is certainly possible and unquestionably necessary for the sake of the people living in rural Southern Kalimantan.

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**Figure 8:** Example of roofing – village housing.


**Figure 9:** Example of roofing – village office.