



FINAL SUMMARY

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AUTHOR'S NOTE: This assessment will not be completed. Recent inspections and developments in sanitation in Aceh confirm a malaise in Aid and Development so entrenched that continuing to pursue the cause of developing sustainable sanitation for rural communities in developing countries, even in the 'Year of Sanitation', is beyond the means of this author.

Given the impacts of poor sanitation on public and environmental health, and given the unprecedented international presence in Aceh, it is an understatement to say our overall performance during reconstruction has been profoundly disappointing.

TSUNAMI-AFFECTED ACEH, A BRIEF BACKGROUND

Acehnese communities were traumatized by many years of armed conflict *before* the tsunami. They were unable to leave their homes between 7pm and 7am because it was simply too dangerous. The streets of cities, towns and villages were deserted at nighttime and the sound of gunfire was commonplace. Every day, people, soldiers, guerilla fighters and civilians, were killed. The Indonesian Red Cross had the gruesome task of picking up bodies, often mutilated, every day. This then was the social context in Aceh when the Boxing Day tsunami wiped out around 200,000 people in a few minutes.

Words cannot describe what coastal dwelling Acehnese went through during and after the tsunami, the biggest natural disaster in modern times. In many cases, these deeply religious people feared it was 'The End of Days'. On the North West coast, several giant waves came ashore, averaging 15m high (50ft) and up to 30m (100ft) in places. On this stretch of coast, almost nothing was left standing, entire communities were washed away.

The author heard too many heartbreaking stories to recount here, but the case of one 50year old village leader in Banda Aceh serves to demonstrate the kind of loss experienced by coastal Acehnese. Pak Baharuddin from the fishing village of Lamtutui, lost his parents, his brothers and sisters, his wife and all six of his children. Only 20% of the people in his village survived.

RECONSTRUCTION

The entire World responded to the disaster, first with emergency aid and then with unprecedented levels of donations and funding for reconstruction. Every major international aid and development organization and agency arrived working with unusually large budgets.



The author first arrived in Banda Aceh, six months after the tsunami having been invited to speak on sustainable sanitation at a major conference jointly sponsored by Greenpeace and the Indonesian Department of the Environment. The aim was to facilitate *sustainable* redevelopment of coastal Aceh, an unprecedented opportunity to implement sustainable development strategies on a massive scale. Unfortunately, the reality, three years later, has fallen far short of the aspirations, to the detriment of the Acehnese and also, the global community.

Communities in coastal Aceh, having survived the conflict and the tsunami, are now encountering a third and largely unnecessary disaster, this time in public health, which can be traced directly to primitive and ineffective sanitation – in other words, sewage and wastewater management. The list of negative health impacts directly and indirectly attributable to poor sanitation is well known. The evidence is indisputable thus prompting the United Nations to declare 2008, ‘The Year of Sanitation’.

There is no other sector, which has so much potential to ease suffering in the developing world yet results in Aceh, where all the World’s major aid and development organizations and agencies invested unprecedented amounts of money, we proved unable to meet the challenge. After millions of dollars of investments and input from many international experts, sanitation standards in post-tsunami Aceh, by and large, remain primitive.

The author, a resident of Indonesia, took an active part in planning for reconstruction. Given the available funding there was real cause for optimism in those early days, however, three years later there is little real evidence of improvement in terms of sanitation standards.

Before the tsunami, the majority of people used concrete rings to line pit latrines and they dumped their grey water into backyard soak-pits, waterways or public drains. Now, after \$6-7billion of total investments, 80% of which came from overseas, the majority of people use still concrete rings to line pit latrines and they dump their grey water into backyards, waterways or public drains. In short, there has been little improvement, especially given the number of foreign experts and extraordinary levels of investment. It is not cynical to state that they did not need foreign experts to help them re-install the same primitive sanitation systems they used before the tsunami.

One must ask, what share of the extraordinary levels of funding provided by compassionate donors in wealthy countries was really used to serve the traumatized survivors in Aceh and how much was simply used to support an opaque, self-serving and unaccountable aid and development industry?

RECENTLY IN ACEH

- The organization charged with coordinating WATSAN in reconstruction in Aceh, well funded and aware of the standards required under Indonesian Law, as well as the stated aspirations of senior officials in that organization, failed to produce results that would properly protect beneficiaries from exposure to preventable sickness and disease.

When information regarding sanitation installations funded by UNICEF was requested for this assessment, he was supplied with press releases stating only that UNICEF funded sanitation for 120 schools (for example). When pressed for a technical description of the systems it transpired that only basic septic tanks for toilet wastes had been provided with no treatment for grey water, which is allowed to flow to public drains untreated. No response was given when they were asked where the septic tanks overflowed to, leading to one of two assumptions: 1. They incorporate soak-pits or 2. They overflow to public drains. These systems, as described to the author by a UNICEF WATSAN engineer, contravene Indonesian Building Codes and they are no improvement over pre-tsunami standards. They will contaminate ground and/or surface waters and they will provide breeding habitat for disease vectors.

UNICEF had the influence, the responsibility and the money, it should at least have attempted to comply with the three basic requirements* listed in the Indonesian Building Codes which, it was widely agreed in 2006, provided achievable standards for sanitation for reconstruction projects in Aceh.

* The three basic requirements listed in the Indonesian Building Codes are:

1. *Watertight* septic tanks
2. No *untreated* wastewater disposed of in public drains
3. In *high* water tables, *horizontal*, as opposed to vertical, flows in leachfields

UNICEF funded many sanitation installations for schools and housing projects but the majority do not comply with Indonesian law and by no means do they adequately protect public health. UNICEF did not ensure the projects it funded made serious attempts at improving standards over the primitive, pre-tsunami status quo. If the coordinating organization for WATSAN, investing many millions of dollars could not, or would not, commit to better sanitation for tsunami survivors, what hope was there that other organizations would show the necessary commitment?

- The author recently came by an assessment of sanitation systems carried out by an international consulting firm, SOGREAH. During his time with USAID/ESP the author was asked by BRR (the Indonesian body overseeing reconstruction) to assist SOGREAH with design for sanitation systems in an area (Meuraksa, Banda Aceh) in which they were commissioned to create a Master Plan for reconstruction.

In response to the BRR request and with support from ESP, the author and an Indonesian colleague designed sanitation systems, which would function in the very high water tables typical of the area then provided these designs to SOGREAH, which, up to then had been *unable to develop any sanitation solutions of its own*.

The provided designs were not installed although subsequently they were used to construct treatment systems in a 2,000house project funded by American Red Cross, thereby demonstrating their technical feasibility.

Recent inspections in Meuraksa showed only primitive sanitation installations* certain to contaminate ground and surface waters and facilitate the spread of preventable sickness and disease. Demonstrably, SOGREAH could not design sanitation systems appropriate for this environment, but it was nevertheless commissioned to carry out assessments of sanitation installations. This poses the question, how does one assess sanitation systems one does not properly understand?

*Open-ended concrete rings and above-ground waste piping

It is especially disturbing that the assessed systems, and note, *most did not function, were listed anonymously to protect the organizations responsible.*

One must ask, on behalf of donors and beneficiaries, where is the accountability and transparency of which non-profits often speak? Why should the identity of the organizations responsible for failed sanitation systems be hidden, is this the appropriate way to deal with technical failures? It seems that aid and development organizations can fail on technical projects with complete impunity and this should be cause for alarm.

- The Asian Development Bank (ADB) is about to issue a tender for sanitation assessments, design and field works in Aceh.

First, the consultant winning the tender is to assess whether sanitation systems funded by the ADB comply with Indonesian Building Codes and the 'Guidelines for Selection and Implementation of Sustainable Sanitation Systems in Reconstruction in Aceh'. (This document, which includes technical designs, was ratified by UNICEF, BRR, USAID, GTZ & OXFAM at a 2 day seminar in 2007, sponsored by UNICEF).

Secondly, the consultant is to design repairs, modifications or rebuilds to bring unsatisfactory systems, or at least the very worst of them, up to a more acceptable standard.

Third, if approved, the consultant is to oversee implementation of the upgrades.

The total budget for consulting and projects is over U.S.\$3million.

As is usual, only pre-qualified consulting firms may bid for the tender, perhaps the same firms, which failed in the first place to produce satisfactory results during reconstruction. There are many requirements for pre-qualification, but it seems that one of them is *not* a proven record designing, or and successfully implementing, *sustainable* sanitation systems in rural or peri-urban areas in tropical developing countries.

The intent in this case is good and the need is very real, however, experience in Aceh suggests that the outcomes will not match the aspirations. Most importantly, experience also suggests that should the project fail to produce the desired results, no one will be held accountable.

The above are only snapshots, random examples of a widespread malaise in international WATSAN, they are not meant to single out these organizations as being any worse than the others, and they do not refer to other sectors of the industry, they are produced here only to demonstrate that something is generally wrong with the way we deliver sanitation in developing countries.

In Aceh, aid and development organizations demonstrated beyond any doubt that they are largely incapable of delivering *sustainable* sanitation systems in tropical, developing countries. In terms of protecting survivor communities from preventable sickness and disease the evidence in Aceh is everywhere and it is indisputable. In the vast majority of cases, regardless of very large investments, we simply failed.

INSTITUTIONAL DENIAL

It is not contentious to state that the majority of preventable sickness and disease in tropical developing countries is caused directly or indirectly by poor sanitation systems and this is the rationale behind the U.N. declaring 2008 'The Year of Sanitation'. That being said, organizations charged with delivering improved sanitation to the developing world are in denial about their inability to do so. Not surprisingly, dengue fever and other illnesses directly attributable to poor sanitation are making a strong comeback in reconstruction communities in Aceh.

SOGREA's decision to hide the identity of the organizations responsible for installing non-functional sanitation systems is one expression of the lack of accountability. Press releases, which blithely state (for example) that.. '*UNICEF funded sanitation systems in 120 schools*' without any reference to the fact that these systems are illegal under Indonesian law and immoral by the principles of due care, further demonstrates of the denial, which is endemic in international organizations and agencies.

If these statements seem extreme, the reader is invited to look at the photos included herein. Photographs do not lie the results are there for anyone who cares to take an objective look.

While corruption in Government can certainly sabotage aid or development programs, in terms of sanitation the larger problem in Aceh lay within the international organizations, which funded around 80% of reconstruction. Manifold reasons, or excuses, have been given for their failures but in the author's opinion one of the central problems was simply a lack of commitment inside the organizations spending the money and this responsibility must squarely be sheeted home to management.

For example, contractors are often blamed for sub-standard outcomes, but if one does not control building contractors daily, on-site, one can hardly complain about their work. Contractors in developed countries do not work unsupervised, why then should they be expected to do so in less developed countries where, in fact, supervision is even more critical? Apart from questions about management, this gives rise to another important issue, the recruitment of personnel appropriate for the task.

Engineers are not always the best people to control work sites. In the author's home country (Australia) work sites are generally supervised by builders (usually tradesmen eg. electricians, carpenters, plumbers) or by professional project managers. Engineers rarely have the hands-on building experience necessary for effective site supervision yet in Aceh, insofar as it was done at all, engineers were almost exclusively given this responsibility. In the author's opinion, far better results would have been achieved if experienced builders and project managers had been recruited for supervision of construction projects.

On a technical note, it quickly became glaringly apparent that international sanitation engineers are not equipped to design sanitation systems for rural situations, in the tropics, in developing countries. In 2006, while working for USAID/ESP, the author conducted four workshops on sustainable sanitation for 190 attendees from most of the organizations working in reconstruction. Most of the attendees were engineers.

When attendees were asked, at the beginning of each workshop, which family of pollutants was the major contributor to pollution of the world's waterways they could not identify *nutrients* as the answer. They were also unable to explain the difference between nutrient cycles in temperate and tropical climates* yet this is absolutely critical to understanding how to design sewage treatment systems. Interestingly, any student of environmental sciences or ecology could certainly have answered these questions and this raises serious issues about the training sanitation engineers are receiving in terms of sustainable environmental management.

*Nutrients do not store in tropical soils, instead, they are largely stored above ground in biomass leading to the conclusion that plant-based treatment systems, constructed wetlands and vegetated leachfields, are most suitable for tropical contexts.

The author subsequently worked with many organizations experiencing difficulty in the high water table environment typical of reconstruction projects. Over and over again WATSAN engineers were unable to design solutions, which adequately protected public or environmental health. Even younger, recently graduated engineers were uninformed about the technical aspects of wetland design and lacked basic knowledge of the functioning of plant-based treatment systems. Some organizations (Oxfam, CRS, ARC et al) nevertheless embraced the concept of plant-based treatment systems and thousands, of varying quality, have now been constructed in Aceh.

Unfortunately, implementation has been disappointing. Apart from issues of poor design and construction, the majority of the systems inspected by the author had no plants or too few meaning they cannot possibly function as intended. A constructed wetland or leachfield without sufficient numbers of plants of appropriate varieties will quickly clog. It is akin to building a car then failing to install an engine. The sad reality is that thousands of these systems, regardless of best intentions, and in the absence of remedial action, will not function as intended.

Once again, the reader should refer to the photos of wetland systems and keep in mind that these are only a random sampling of projects they are by no means a thorough or complete compilation.

SYSTEMIC FAILURES

International WATSAN engineers certainly lack capacity in terms of designing and implementing *sustainable* sanitation for the tropics but the gap is covered up by management and administrative systems, which, persistently value written reports over real results in the field. There is little disincentive against failure, but there are very strong incentives to provide reports, which support the *appearance* that the organization is doing a good job. Any reader who disagrees should attempt to find another published report or assessment, which honestly describes the failures documented by the attached photographs.

The reader is reminded that this was probably the largest, and perhaps best funded, reconstruction project in history and that 2008 is the U.N.'s 'Year of Sanitation'.

Aid money comes with strings attached. European funding will require that a European organization or company carries-out most of the work. The same is of course true of most international funding and this would not be such a problem if those companies and organizations had the capacity to do the work well, and *if they were held accountable for the results*. At present, there is little accountability or transparency other than that routinely imposed on beneficiaries. When the author asked a senior finance officer from the head office of one of the largest Red Cross's how a donor would find out how much they had spent in Aceh and what they had achieved with the money, she replied that it would be impossible.

The author does not herein seek to criticize individuals but rather the systems in which they are working. During the three years the author worked in Aceh, he was frequently cautioned to be careful when criticizing field results. He was consistently warned that being critical would result in him being unable to secure new contracts, regardless of his commitment or results in the field. This has indeed proven to be the case and this partial assessment is likely to be his last contribution to the cause of sustainable sanitation in Aceh.

The author does not come from a background in aid and development and was therefore very surprised at the level of fear carried by career aid workers. An unwritten rule binding workers to a policy of unreserved support and denying real opportunities for positive criticism seems to dominate the industry. It is implicit, accepted as *de rigeur* that criticism will interfere with future work prospects. When workers in aid and development are too frightened to criticize field results there is something seriously wrong with the industry.

A SUMMARY OF SOME ISSUES OF IMPORTANCE

- **Management and administrative systems in aid and development organizations and agencies do not support best results in the field instead they support reporting, which enhances the image of the organization.**
There is a major disconnect between the stated aims of aid and development organizations and their systems of incentives and sanctions. These skewed incentives work powerfully against transparency and/or accountability and this is routinely acknowledged as ‘the way it is’ by aid and development workers. Only those, usually in management, seeking to protect the reputations of these organizations, and by implication, their own job security, will argue that this is not the case.
- **In Aceh, there were too many engineers, academics and administrators and too few people with practical, hands-on experience.** Recruiting practices focus too much on academic qualifications and too little on a proven track record of achieved results in the field*. There is too much emphasis on engineering and administration as opposed to, for example, the life sciences or the commercial sector. There is also an implication that only career aid and development workers understand the issues in this industry, although workers from outside the industry, with practical real-life experience, will in fact, often be capable of doing an excellent job.

*Note that the author is not an engineer, yet he conducted trainings and workshops, assisted large organizations with technical design and wrote the technical sections of the ‘Guidelines for Sustainable Sanitation..’ document, which was ratified by most of the major players. The author also designed the plant-based systems installed in 2,000 houses by BRCS/ARC in Aceh Jaya, arguably the best large-scale sanitation project in Aceh. Although he does not hold a relevant university degree, he was nevertheless able to achieve real results because of extensive practical experience and private research.

Having witnessed the process from the very beginning, it is the author’s opinion that planning for reconstruction would definitely have benefited from the inclusion of experts from the life and environmental sciences who have a broader overview than engineers, as well as practical input from people with real, as opposed to theoretical, experience in commerce*.

*A colleague of the author’s with 20years experience running SME’s in Indonesia interviewed with several livelihoods programs being run by large organizations in Aceh. After the interviews his comment was, ‘There are no livelihoods in the livelihoods programs’.

Put simply, and in generalized terms, engineers and administrators are not qualified to design whole new communities but that is exactly what happened in Aceh.

Where they exist, environmental advisors are too often seen as holding a token position, devoid of any real power to enforce important recommendations. Spatial planning, by modern standards, showed, by and large, an appalling failure to accommodate human needs. Witness the grid pattern layout of most new settlements. Programs for economic development, which were designed and carried out mainly by theoretical economists and social scientists has likewise been a dismal failure. An honest cost benefit analysis would reveal large investments in foreign consultants for little long-term benefit to the Acehnese economy.

- **There was little coordination between players in reconstruction.** This not only applies to cooperation between organizations, but also to different departments within the same parent organization. The author worked (on sanitation) for the environmental programs of USAID and GTZ but, although sanitation is implemented mainly to protect public health, he never met with colleagues from their health programs. Health workers have to deal with the negative consequences of poor sanitation installations but they have absolutely no input into sanitation programs.
- **In Aceh, although desperate for work after the tsunami, local experts were repeatedly passed over, while experts from Java received most of the (highly paid) contracts.** There were two main reasons for this: the experts from Java were more likely to speak at least rudimentary English, and, the main offices of the big players and therefore the recruiting, was usually done in Jakarta or one of the other big cities on Java. This skewed recruiting process created problems and missed opportunities. It also served to reinforce existing tensions at a time when encouraging reconciliation was the stated aim of all the big players.
- **The standard tender process,** ostensibly there to produce transparency and the most economical outcomes, **is fatally flawed.** Time and again tenders failed to produce the desired results, if organizations and agencies are genuine about improving outcomes, it is clearly time to change the system whereby contracts are awarded.

Although most tenders in Aceh were overseen by foreigners corruption still flourished instead of being controlled. The author had personal experience of this during a particular tender process. When he reported the in-house engineers who were colluding with a contractor and recommended disciplinary action he was instructed to change his work report or not be paid.

One only has to consider the sheer size of the reconstruction effort to deduce that significant corruption would take place. Logically, if aid and development organizations were making real efforts to control it, regular reports of punitive action would have surfaced. Although there may have been others, the only publicized report of serious action being taken, that the author recalls over three years, was taken, much to their credit, by Oxfam.

The 'standard' tender process meant that larger contractors, often from Medan or Jakarta, had a significant advantage over smaller local contractors who might otherwise have been perfectly capable of doing the project. Work and profits flowed out of Aceh creating hardship and resentment in the local business community.

The author recently completed a project in Aceh, which had been tendered by a head office in Jakarta. The successful bidder then sold the project to another contractor who subsequently sold it on to yet another contractor who, unsurprisingly, did a very poor job because, by that time, there was insufficient money to do the job properly. In the author's experience, a local contractor would have been more likely to do a reasonable job and being locally based, would have been much easier to supervise.

- Many young ‘experts’ were employed in reconstruction. Unfortunately, they did not have sufficient practical experience and often *experimented* with solutions for real world problems. Short-term contracts also work against good outcomes. As a colleague pointed out, ‘They spend their first month trying to figure out where they are, their second month actually doing something and their last month writing applications for their next contract’.

While working with a German organization the author witnessed the design and installation of a wholly inappropriate drainage system for a ‘model’ community, the whole project was carried-out by a young engineer (with approval from management). Concave, gabion-like structures (only appropriate for high velocity flows) were constructed in roadside drains *with no slope*. Being stone and wire they were unnecessarily expensive, they are impossible to maintain free of weeds and in any case they have now collapsed. No engineer with practical experience in drainage would have employed this design.



By contrast, the author worked with a French organization, which employed a builder to manage their projects with young engineers working under him. Most of the staff worked from beginning to the end of the project and although they lacked experience, the supervising builder’s practical skills combined with their long-term commitment resulted in very good outcomes.

- **Although there is a major focus worldwide on more sustainable environmental management this was not generally reflected in the actions of WATSAN engineers in Aceh.** Although the author spent considerable time with engineers who were designing water supply systems, often assessing springs in the foothills as a source, he never heard the expression ‘environmental flows’ being used. No regard was given to the environmental consequences of taking *all* the water, if 50litres/second flowed out from a spring that was the volume calculated for use in the supply system.

Perhaps most galling of all, the potential for many locals to have their own, secure, household water source was ignored. Many reconstruction settlements had abundant groundwaters free from industrial pollution. **Backyard wells had the potential to provide secure water supplies to each household. Sadly, this golden opportunity was lost, precluded by the installation of inappropriate sanitation systems.**

Open-ended and/or leaky concrete rings, essentially lined pit latrines, are the most common example of inappropriate sanitation installations widely implemented during reconstruction. This 'system' functions only as a direct pipeline for toilet wastes straight into the groundwater, which is typically less than 1.5m in reconstruction settlements.

- Even where large investments were made and sanitation outcomes were quite good, **follow-up for the inevitable problems arising in the first few months after hand-over has, in most cases, not been provided.** In the West, one does not handover a new building and walk away, there are always problems in new buildings and these must be addressed as part of the overall process. The author recently inspected one of the best sanitation projects in Aceh where, **as small problems arise, and in the absence of any technical support or follow-up, occupants, lacking expertise, have simply disconnected the fundamentally sound sanitation system and gone back to open-ended concrete rings.**

A FEW TECHNICAL ASPECTS OF SUSTAINABLE SANITATION IN THE TROPICS

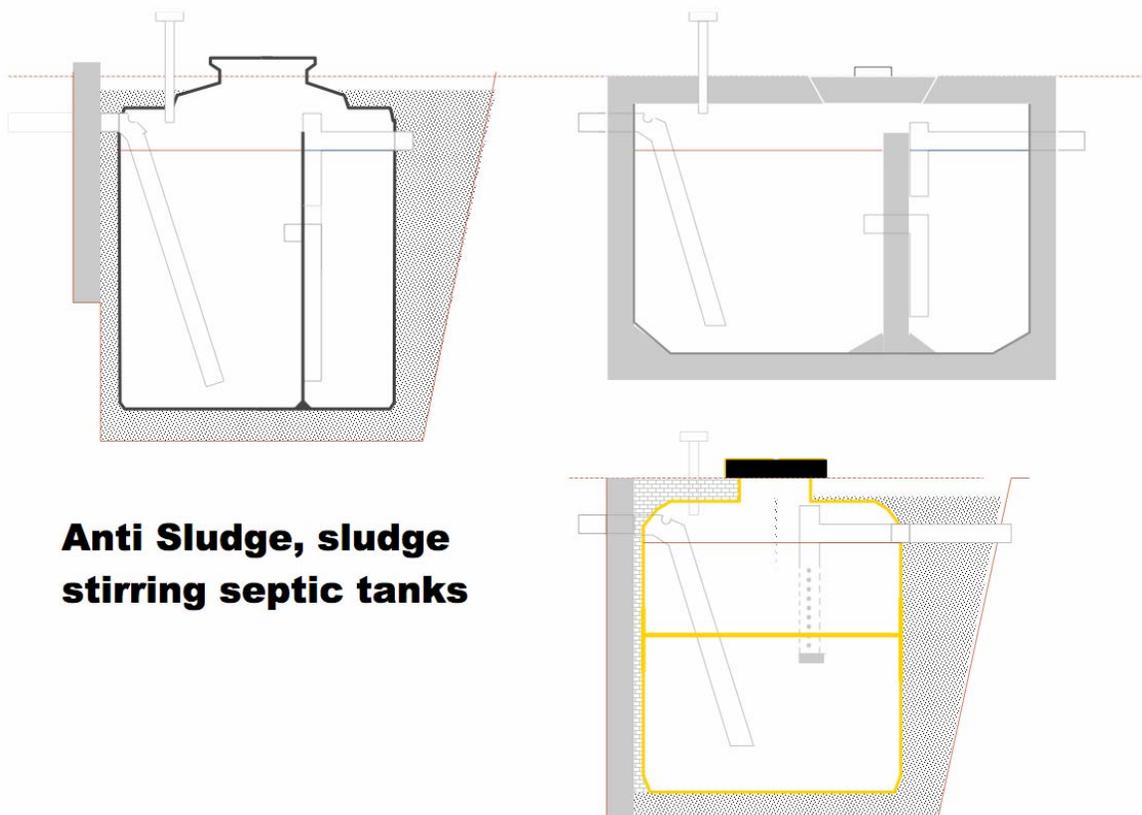
Included herein are pdf copies (**ARC/BRCS**) of technical drawings for systems* designed by the author for a 2,000house project funded by American Red Cross and implemented by the British Red Cross Society in Aceh Jaya. Four hundred of the homes are in frequent flood zones, in response, these elevated houses had raised, above ground treatment systems installed to prevent contamination of floodwaters. It is acknowledged herein that these systems are generally too expensive for low-income communities however they do set a high standard for plant-based, sustainable sanitation, in the tropics, in rural or peri-urban settings, *where budgets allow*.

*Systems (SPE) are comprised of a 1,000liter watertight septic tank, a 4sqm watertight, subsurface flow wetland and a 6sqm vegetated leachfield. Total area required was 14sqm. Configuration of each system was made to fit each individual house plot.

A less efficient but much cheaper alternative is shown in the attached pdf file (**Basic Anti-Sludge* System**). This system does not require pump-outs and does not have any outflows, all wastewater passes through the septic tank to a vegetated leachfield. *It is critically important that the leachfield is large enough and that it is planted with a sufficient number of appropriate varieties of plants.* It can rightly be argued that this system might still pollute groundwaters however, the real question should be, is it significantly better than the status quo in low-income communities?

*The author has been employing this simple anti-sludge strategy for years with success. Basically, the inlet pipe is extended to near the bottom of a single chamber septic tank. A small hole above the liquid level allows air to escape. A normal sludge blanket maintains anaerobic conditions in the tank. Inflows stir sludge into suspension. Suspended solids then flow to a plant-based treatment system, a ssf wetland and/or a vegetated leachfield. The rationale behind the design says that the root/gravel matrix is able to process the suspended solids, mainly nutrients and organic carbon, precluding clogging. This indeed has been the author's experience over the last 7years.

- Conventional wisdom sometimes works against the development of more appropriate new treatment systems.** For example, one of the basics tenets of conventional sanitation is that solids must first be settled-out (in septic tanks) for regular pump-out, treatment and disposal. Of course this presents major problems where pump-outs may not be available or affordable for low-income communities. There is also the issue of where the sludge will be treated. In developing countries final disposal is often into rivers, drains or the sea. Plant-based systems have the capacity to treat solids in suspension, solving the sludge problem, but this is generally not understood or accepted by engineers.



Anti Sludge, sludge stirring septic tanks

- P Traps** are virtually unknown in rural communities yet they are a very important component in grey water piping. In the majority of projects inspected by the author, no P Traps were installed meaning bad smells (& insects) entered bathrooms from septic tanks, drains or soak-pits.
- Regardless of contract specifications, septic tanks are generally not carefully inspected and so were not taken seriously by builders, this resulted in very poor construction and/or installation standards. This is extremely important because **a leaking septic tank causes groundwater pollution and renders secondary treatment systems useless.** During reconstruction in Aceh, implementing agencies found it impossible to achieve watertight concrete septic tanks built on-site so it was finally agreed by at least some of the major players that purchasing and installing prefabricated tanks was the only practical alternative.

It must be noted here that a lack of adequate site-supervision contributed significantly to this very serious problem. Organizations frequently blamed contractors for poor standards but this ignores the principle of due care, which states that contractors should always be well supervised. A properly supervised contractor cannot get away with sub-standard work. In the author's experience, by far the best results were achieved where builders with practical, hands-on experience were employed to supervise work sites. Engineers, being office-based, are generally poorly equipped for this task.

- Widely available **plastic water tanks may be converted for use as septic tanks.** They are reasonably cheap, strong, durable and watertight. They also have a well-sealed lid and it is relatively easy to make watertight pipe-penetrations if care, a good sealer (*Sikaflex* is excellent) and screw joints are used at the penetrations. Some allowance should be made for soil conditions, where crushing is deemed a risk, simple reinforcing structures may be constructed to protect them. In most cases however, in the author's experience, these will not be needed.
- Plant-based treatment systems function well if certain basic rules are adhered to, however, in the author's experience, these rules are, in general, not well understood by WATSAN engineers. As with any engineering project, if the rules are broken the project will not meet expectations. Listed below are examples:
 1. *No soil* in constructed wetlands – soil clogs the pores. Soil often enters during construction so careful supervision is required. Wetlands should be protected (by a low wall) from soil entering the system in overland flows during heavy rains.
 2. *Size of the gravel* (the medium) is important – too large reduces surface area for microbes, too small risks clogging.
 3. *Appropriate plant species* only – selected plants should take up large quantities and a wide range of nutrients. Wetland plants, reeds, rushes and cattails, although most commonly used, are by no means the only suitable species. Food, for example bananas and papaya, may be grown safely in domestic wastewater systems, especially vegetated leachfields. Animal fodder may be grown as can appropriate landscaping plants. Vetiver grass is a unique species that is especially suited as its deep root system allows for much deeper wetlands with relatively greater treatment capacity per square meter of space.
 4. *Sufficient plants* must be used – insufficient plants cannot properly 'process' wastes. Thousands of wetland systems have been installed in Aceh although most of those inspected by the author were grossly deficient in plants. Insufficient plants means the systems will not function properly and will likely clog.
 5. *Size of the system should match expected capacity* – systems may be smaller in the tropics because of continuous biological activity and rapid biomass production.
 6. *Subsurface flow wetlands must be watertight* – leaks will cause wetlands to dry out and plants to die. Care must be taken during design (especially selection of materials) and installation/construction.

7. *In the author's opinion, a 20-30cm layer of sand on top of the gravel medium is beneficial* – once plants are established, the sand layer remains very stable above the gravel. Counter-intuitively, no membrane or barrier is required to stop the sand migrating downwards.
8. *In the author's opinion, plant-based systems are capable of processing suspended solids from septic tanks* – the author's oldest anti-sludge system is a public toilet, which has not been pumped out since commissioning, six years ago. This particular system, in a very dry area, actually recycles water from a storage tank, through the toilets, to an anti-sludge septic tank then through a ssf wetland to a small holding tank equipped with an automatic pump, which lifts the treated water back to the storage tank for re-use in the toilets.

The list above is not complete, it is however indicative of rules, which apply to plant-based treatment systems in the tropics.

WASTEWATER - POLLUTANT OR RESOURCE?

In a world experiencing water and nutrient shortages, not to mention widespread environmental degradation, wastewater is a resource we can no longer afford to waste. The author met someone who was about to head a team designing mass sanitation systems for refugee camps. When asked what they do now he responded that they dig a hole, when it's full, they cover it and dig another hole. I proposed that in, for example, sub-Saharan Africa, it might be useful to grow some food on the scarce water and nutrients provided by large quantities of wastewater. This had not occurred to him although to his credit, he thought the idea had merit.

The author's family runs a small eco-lodge (www.baliecolodge.com) in which vegetated leachfields are used for disposal of septic outflows. Guests at the lodge have enjoyed bananas and papayas (not to mention flowers) grown on wastewater for years without any ill effects. Sustainable liquid waste management means that the clean mountain stream which borders the property is still clean when it leaves the property.

CONCLUSION

If doing our best to protect community and environmental health were the aims of sanitation programs in Aceh, by and large, we failed. Truly enormous investments did not significantly improve on the very poor standards, which constituted the status quo before the tsunami.

There are some absolutes, things which cannot, and should not, be debated. Leaky septic tanks and open-ended concrete rings in high water tables cannot, by any reasonable measure, be deemed acceptable. Allowing untreated wastewater to flow into public drains where it stagnates breeding disease vectors and human pathogens cannot, and should not, be defended as an acceptable outcome of well-funded aid or development programs.

Indonesian Law, the National Building Codes, provided a set of basic and achievable guidelines, which all organizations and agencies could, and should, have applied in reconstruction projects. That the vast majority of projects failed to achieve these basic requirements is an indictment of the international aid and development industry.

Simply defending the industry, making excuses, is akin to an alcoholic, offering plausible reasons why they should continue drinking. Until the industry admits it has a problem, it is unlikely to improve its performance in this most critical of areas.

Solutions, not just those discussed herein, already exist, but perhaps more importantly, there are many opportunities for further development. Universities and technical colleges urgently need to conduct practical research and develop courses, which will equip graduates to work effectively in diverse and challenging environments. There are no magic bullet solutions, no 'one size fits all' remedies. The 'cookie cutter' approach is not a good model for sustainability. There are however Universal Guiding Principles and it is these that must be learned, understood and applied by aid and development workers.

Preventing human contact with raw effluent is not enough. The downstream health impacts of discharging effluent into drains, waterways and groundwaters are extremely serious and need to be addressed not avoided. Poor sanitation is the primary cause of non-industrial water pollution and is linked to the majority of sickness and disease afflicting communities in developing countries. Sanitation engineers and the organizations, which employ them, have a critical responsibility to do more to safeguard public and environmental health.

Denial will not solve the problems and glib press releases do not represent the real situation. Publishing this material is an attempt by the author to shine some light on an otherwise dark side of aid and development.

In Aceh, real people, not just numbers on a page, already deeply traumatized by years of armed conflict and the devastating tsunami are now suffering needlessly because we didn't do a better job. I can only assume that, in terms of sanitation, this story is being played out the same way all over the developing world.

The aid and development industry vigorously promotes itself as caring, effective and responsible. Failing to take the capacity-gap in sustainable sanitation more seriously by aggressively defending the industry instead of acknowledging there's a problem, makes nonsense of claims of care and compassion. Hiding failures behind vacuous press releases facilitates more failures and undermines the long-term standing of the industry.

In a world increasingly in need of sustainable solutions, we have the resources but do we have the commitment?

