Discussion

Deep impact: why post-tsunami wells need a measured approach
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The classical freshwater/saline relation in coastal sedimentary aquifers as shown in Fig. 3 demonstrates the ideal situation which may be considered to have been in equilibrium. That this general equilibrium has existed is shown during extreme dry seasons when the saline ground water has the upper hand, resulting in brackish water rising into even quite shallow wells and the Sri Lankan 'tanks' (reservoirs) near coastal areas. When the north-west annual monsoon rains return and the land gets soaked and flooded, the brackish water is depressed to the lower levels and there is fresh water in abundance as potable water returns to near surface levels and the land becomes green again. The low specific gravity is key to helping to keep the fresh water in the top layers. I have seen this personally in my younger days in the Kayts Island in Northern province, which is surrounded by the Jaffna lagoon of seawater from Palk Straits. This has been the cyclic pattern since time immemorial in these seasonally dry zone areas of Sri Lanka. The author's study area is in fact in the dry zone in the Eastern province. It is cited in a Ceylon colonial government report that the great epic and chronicle *Ramayana* and *Mahavamsa* referred to earthquakes and tidal waves.[9] Volcanic activity from Krakatau in Sumatra and later events record tsunamis of various magnitudes which are discussed in another paper on tsunamis that affected Sri Lanka.[10] How the people coped with water supply in these past catastrophes is a matter of conjecture.

It would be natural and instinctive to think of pumping out the tsunami seawater from wells but this proved to be misguided, as the author had reported. Removal of debris and dead animal carcases is one thing but, in these ground conditions, to go beyond general cleaning proved wrong. It is of concern that despite the wealth of knowledge from other countries which have also had recurring tsunamis, no reliable knowledge transfer took place to help the local people. In the event, the author is probably correct with the comment that 'in some circumstances, the best course of action is to do nothing.' Taken in this form, the comment from the research is a bit of a let down, as it does not give a positive guide as to what action is likely to be best.

Perhaps the author could comment if there are any established chemical means that could have been used to find accelerated solutions, if only to cover that immediate post-event period. Or, would a simple and slow direct recharging of the wells with fresh water from water reservoirs outside the affected zone width of 300 m from the coast have done the trick to recreate those essential fresh-water lenses and push the seawater further down more quickly?

Another point highlighted by this study was the apparent very close proximity of drinking/domestic water wells to family latrines and possibly to garbage pits; this is particularly disturbing unless the wells were properly lined vertically in the pollution zone as reported by Franceys *et al*.[11] This guide gives a typical figure of 15 m as a minimum. The author's reference to a figure of only 10 m is the same as that given in the field handbook Engineering in Emergencies,[12] but the shallow 10m depth is a little

concerning in such porous soils. Perhaps what was intended was the same figure of 15 m based upon Franceys *et al.*'s work?

Notwithstanding all this, is it not time to strengthen planning regulations and procedures in the Sri Lankan provinces or, for that matter, in any remote villages in any part of the world? As 2008 is designated as good sanitation year, is it now timely to develop an ISO or world-class standard in the interests of public health for developing countries, together with suitable training for key staff and emergency response teams? Perhaps it is also timely to review and update Franceys' research on pollution and well siting.

On a practical level, a simple inquiry from those in the field to the Institution of Engineers Sri Lanka in Colombo or ICE in London libraries resources would reveal the sources of much design information and guidance on siting toilets (closed or with overflow designs) in the vicinity of domestic water wells and the essential precautions to be taken in the management of such systems. These knowledge sources and related other sources carry useful reports on dewatering and tackling drinking water wells contaminated by sea water.

Author's response

It was not my intention to imply that only local people were misguided in their well-cleaning activities. An alarming proportion of the international aid community were conducting 'well rehabilitation' in an equally inappropriate manner. Therefore, there is an urgent need to ensure that appropriate knowledge is held within both international and local communities. Advice to do nothing may be frustrating, but it is better than intervening in such a way as to exacerbate the problem.

There are no chemical means of improving the situation described and, in the case of the reported study, no recharging of wells would have been possible as the water table was already at ground surface. Furthermore, just as contaminated well water discharged to the ground surface percolates back into the wells, so also would recharge water, discharged into wells, lead to outflow at the adjacent ground surface and to resultant standing water.

The proximity of the latrines to the wells in this area is disastrous from a public-health point of view. None of the distances mentioned are adequate for a highly permeable water supply aquifer where the water table is above the base of latrine pits.

Yes, by all means strengthen planning regulations but remember that the communities affected on the east coast of Sri Lanka are amongst the poorest. Latrines that drain into the aquifer are ubiquitous and private wells are often the only available water supply. In order to be effective, improved planning regulations would have to be twinned with significant infrastructure investment.

Finally, it is hard to imagine what advice any of the institutional resources cited by the contributor might provide for the case described.

References

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12. DAVIS I. and LAMBERT R. *Engineering in Emergencies (2nd edn)—A Practical Guide for Relief Workers*. ITDG/RedR, London, 2002.