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## Short-cutting the Phosphorous Cycle in Urban Ecosystems

Bekithemba Gumbo  
2005, Taylor & Francis  
([www.taylorandfrancis.co.uk](http://www.taylorandfrancis.co.uk))  
ISBN: 0415384842, paperback,  
£61.95

All plants depend upon phosphorus (P) for growth and the P-cycle is integrally linked on the one side to the production of food, and on the other to the management of human excreta. In natural ecological systems, the P-cycle is a balanced and closed-loop system in which the element is continuously recycled and reused. Modern agricultural farming practices depend upon the continual application of synthetic fertilizer to support crop production. The decreasing availability of natural P deposits in the soil combined with the accumulation of P in the natural environment have led to increasing concerns about the sustainability of current practices and a focus of attention on strategies to mitigate associated environmental problems.

The focus of these strategies is to promote practices that are akin to natural cycles; including those associated with sanitation systems and the management of human excreta. In addition to satisfying other demands of good sanitation related to the protection of public health, the focus and main benefit of ecological sanitation (ecosan) is the recycling of nutrients (both nitrogen and phosphorus) contained in excreta back to agricultural land. In this book, which is based upon the dissertation of Dr Bekithemba Gumbo and is the final output from his research studies at

UNESCO-IHE / TU Delft, the author focuses on the potential to adopt ecosan systems as a means of reducing the loss of P from land-based systems into aquatic system.

He presents a methodology for measuring the impacts of various ecosan strategies within urban ecosystems. To test the viability of ecosan, the author developed a computer model (dubbed the phosphorus 'calculator') to simulate flows of water and P in an urban catchment. The model was developed and calibrated based upon studies of monthly P-fluxes in a high-density suburb of Harare in Zimbabwe. Agriculture is an established activity in the environs surrounding the suburb and there is a build up of P in the nearby Lake Chivero. The results from the model are used to compare various ecosan strategies with conventional sanitation in order to test the feasibility of these concepts to recycle P.

The scenarios simulated using the model include urine diversion, involving storage and application onto arable land, and stabilization of organic waste by composting or anaerobic digestion of excreta prior to reuse in agriculture. According to the results of the analyses, urine separation is identified to be the most sustainable option. P in detergents in grey water is insignificant in terms of supplying adequate quantities required for crop uptake. Therefore, recycling of greywater is the preferred option from the perspective of water resource conservation but not for the recycling of Phosphorus. Bekithemba advocates the adoption of a combination of these strategies which focus on different aspects of nutrient and wastewater recycling.

The analysis provides an invaluable quantitative assessment to assist in the ongoing debates in the sanitation world in relation to the pros and cons of ecological sanitation. Although the author focuses predominantly on a macro-system analysis of different options, he recognizes that there are potentially major constraints associated with the successful implementation of ecosan technologies. These are particularly associated with ensuring that collection rates of urine are sufficiently high to make it worthwhile and also that cultural barriers related to the acceptance of ecosan technologies may be significant.

Although not written as an introduction to ecosan, the book contains a wealth of information of interest mainly for students and for other researchers. In addition to the core text of the thesis itself, Bekithemba includes considerable additional information in the form of numerous text boxes, which makes the book considerably more attractive to pick up and browse than the majority of theses. The production is excellent – especially considering that the author will have produced all the diagrams and maps personally. I congratulate Bekithemba for an extremely impressive piece of work which reflects the detailed research that he undertook during PhD studies.

*Jonathan Parkinson is the Principal Consultant, Water Resources Management, Atkins International*

## Greywater management in low and middle income countries – review of different treatment systems for households or neighbourhoods

Antoine Morel and Stefan Diener  
2006, Swiss Federal Institute of Aquatic Science and Technology (EAWAG), Dübendorf, Switzerland.  
Can be downloaded from [http://www.sandec.ch/Wastewater/DEWAT\\_Greywater.htm](http://www.sandec.ch/Wastewater/DEWAT_Greywater.htm)

The Greywater management manual provides an insight into selected technology options for collection and treatment of greywater in developing countries. The manual is divided into five sections; the first section focuses on the rationale for greywater management, followed by a second chapter on definitions of greywater. The third chapter of the book is highly informative and focuses on the physical, chemical and microbiological characteristics of greywater. In addition to the information contained in this chapter, the reader can refer to Volume 3 of the World Health Organisation (2006) Guidelines for safe excreta, wastewater and greywater which provide greater detail on risk-based approaches to greywater safety management. The remaining two chapters outline selected technologies that can be used for greywater management with reference to some interesting case studies.

Like any book, the manual is limited to only a review of selected technologies.

Essentially, the manual focuses on a review of direct non-potable applications of greywater for irrigation. In addition to this, the book would benefit from reference to the use of greywater technology for indirect potable applications such as toilet cleaning/flushing such as that outlined in the Godfrey et al. (2007) article in *Waterlines*.

Overall, the manual is a useful introduction to the subject of greywater management. It emphasizes the importance of greywater management as a critical component of any total water management solution.

### Reference

Godfrey, S., Labhassetwar, P., Swami, A., Wate, S.R., Parihar, G., Dwivedi, H.B. (2007) 'Water safety plans for greywater in tribal schools, India', *Waterlines* 25:3

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## Corruption and Transparency in the Water and Sanitation Sector Thematic Overview Paper 16

Kathleen Shordt, Laurent Stravado and Cor Dietvorst

2006, IRC (International Water and Sanitation Centre), The Netherlands

This paper is a comprehensive and useful study of the subject, with extensive references to other work carried out in this field, and some useful comments on lessons learned so far. In the opening summary it states: 'Corruption undermines water and sanitation services. It is those without voice, the poor, who are systematically deprived by corrupt systems'. The paper focuses on the following features, defined as:

- corruption: the abuse of entrusted power for private gain;
- honesty: trying to work and act in a way that reflects known best practices; and
- transparency: sharing information and acting in an open manner.

While most people will accept the definitions of 'corruption' and 'transparency', the assumed meaning of 'honesty' is unexpected. 'Honesty' is usually taken to mean being honest and truthful.

Information in the paper is drawn from a wide range of sources, in which the NGO Transparency International is significant, together with the World Bank and its agencies, and the U4

Utstein Anti-Corruption Resources Centre's website, supported by DGIS (Netherlands), DFID (UK), SIDA (Sweden), CIDA (Canada) and NORAD (Norway). The paper is, however, rather short of information from indigenous sources in developing countries.

There are four appendices: Definitions; Typology – a catalogue of challenges; Tools and actions for the water sector; and List of international conventions and donor policies, followed by copious references.

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## Fluoride in drinking-water

Fawell, J. et al. (eds)

2006, Switzerland, World Health Organization, US\$63.00, ISBN:

9241563192, 144 pp, downloadable from [http://www.who.int/water\\_sanitation\\_health/publications/fluoride\\_drinking\\_water/en/index.html](http://www.who.int/water_sanitation_health/publications/fluoride_drinking_water/en/index.html)

Residents of a village in Andhra Pradesh, India once told a story about how they coped with excessively high levels of fluoride in their drinking water. Taking advantage of being dairy farmers, they shipped fresh water home in the empty churns used to sell milk everyday hundreds of kilometers away in the city of Hyderabad. Ingenious though this was, transporting fluoride to the city in milk was not a good solution to the problem faced by these villagers, and a new book in the WHO drinking-water quality series highlights the difficulties in finding good solutions to deal with high fluoride levels in drinking water.

Fluoride occurs naturally in many parts of the world, and under certain circumstances, for example when there is little calcium in the rocks forming an aquifer, groundwater can contain dangerously high levels. We learn that in a temperate climate, a fluoride concentration of around 1 mg l<sup>-1</sup> is optimal. Less can lead to dental decay. More can lead to dental fluorosis, where the teeth become stained or pitted, and above 10 mg l<sup>-1</sup> to crippling skeletal fluorosis. Extrapolating, it is projected that 70 million are suffering from fluorosis, most in India and China although other areas, such as the African rift valley, are badly affected.

This book therefore catalogues an important subject, and does so in an

accessible way. You need not be a chemist to follow the concise text, which is full of interesting information, while surveying a serious topic. We hear for example about the high levels of fluoride that some Chinese are exposed to through burning coal in their homes, and Tibetans who drink brick tea (made from old leaves). But most people are exposed to elevated levels of fluoride through their drinking water.

Five main thematic chapters cover the occurrence of fluoride in the environment, its effects on human health, guidelines and standards (the safe guideline is 1.5 mg l<sup>-1</sup> but has to be adapted according to diet and the higher levels of water consumed in hot climates), treating water to remove excessive fluoride, and analytical methods to measure fluoride in water. A concluding survey discusses fluoride and its observed effects in 28 countries where high levels have been reported.

The available evidence is presented in a balanced way, with a large number of cited references. The challenges are highlighted, such as the failure to successfully scale up the use of treatment methods that have all been known since the 1930s. Given these difficulties, the book rightly emphasizes the first choice of looking for alternative sources with better quality, but this is not explored further. It is not uncommon in some locations to find that people don't drink the best quality water in their area due to a lack of information. That information gap is unlikely to be filled by the expensive (mainly laboratory) analytical methods that are covered in this book, with no comments made about the reliability or otherwise of cheaper field kits and methods.

Readers looking for a broad introduction to the issues of the fluoride in drinking water, will find this book an excellent place to start.

The book costs \$63, but is available at a reduced price for developing country readers. It is published by both the International Water Association ([www.iwapublishing.com](http://www.iwapublishing.com)) and the World Health Organisation ([www.who.int/bookorders](http://www.who.int/bookorders)), and is also available for free download (see above).

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