A 3-step strategic approach to sustainable wastewater management

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Abstract

Many cities in developing countries are facing surface water and groundwater pollution problems. This deterioration of water resources needs to be controlled through effective and feasible concepts of urban water management. The Dublin Principles, Agenda21, Vision21, and the Millennium Development Goals provide the basis for the development of innovative, holistic, and sustainable approaches. Whilst highly efficient technologies are available, the infusion of these into a well-thought out and systematic approach is critical for the sustainable management of nutrient flows and other pollutants into and out of cities. Based on cleaner production principles, three intervention steps are proposed in this paper. The first step is to minimise wastewater generation by drastically reducing water consumption and waste generation. The second step is the treatment and optimal reuse of nutrients and water at the smallest possible level, like at the on-plot and community levels. Treatment technologies recommended make the best use of side products via reuse. Once the first two intervention steps have been employed to the maximum, the remaining waste flows could be safely discharged into the environment. The third step involves enhancing the self-purification capacity of receiving water-bodies (lakes, rivers, etc.), through intervention. The success of this so-called 3-step strategic approach requires systematic implementation, providing specific solutions to specific situations. This, in turn, requires appropriate planning, legal and institutional responses. In fact, the 3-step approach could be applied as an overall approach for waste management, although here the focus is on sewage. This paper offers examples under each step, showing that the systematic application of this approach could lead to cost savings and sustainability.

Keywords: cleaner production, nutrients reuse, 3-step strategic approach, sustainable approaches, urban water cycle, wastewater management

Introduction

Many countries are currently facing an environmental dilemma due to rapid population growth and urbanisation, and the related enormous quantities of waste generated in their cities. It is estimated that of the current world population of 6.1 billion, about 47% live in cities, with these cities having an average annual population growth of 2% (UNFPA, 2001). The annual average world population growth is estimated at about 1.2%, resulting in increased energy, food and material demand. Urban migration, due mainly to decreased agricultural production in rural areas and increased job opportunities in towns, has given birth to mega-cities, especially in developing countries. The hopes for job opportunities and a better life in cities have sometimes been dashed by poor performances of most economies, often leading to economic difficulties. The results in some cities have been disastrous as the cities have failed to cater for most residents, the majority of whom make no financial contribution to the development of their communities.

One of the numerous problems being faced by many cities is the management of waste(water) generated, resulting in serious pollution of downstream water-bodies. In some cases the problems have been localised whilst in others pollution has been allowed to cross boundaries, in itself a potential cause of conflicts. Well-known examples include the river Rhine in Europe, and the Nile River in Africa. Nutrients - nitrogen, phosphorus and potassium (NPK) - are known to cause serious eutrophication problems in water-bodies and require proper control. The advent of uncontrolled urban agriculture, passively allowed in most African cities, has compounded the problems as increasing loads of fertiliser are imported into cities. Although urban agriculture seems to offer a logical destination of nutrients in wastewater, not enough emphasis has been placed on this option? There has been little attempt to link wastewater management to urban agriculture despite the logical connection between them. Instead, synthetic (artificial) fertilisers have resulted in an additional stream of nutrient inflow into urban areas. For example, Gijzen and Mulder (2001) did a detailed analysis of the natural and anthropogenic nitrogen cycles and clearly showed an imbalance in nitrogen inflows and outflows from cities. The same arguments can also be advanced for phosphorus. The current mineral reserves for phosphorus will only last for 100 to 150 years at current levels of consumption (Otterpohl et al., 1997). Future strategies for increasing agricultural productivity would have to focus on using available nutrient resources more efficiently, effectively and sustainably than in the past. The abundance of nutrients in domestic wastewater can no longer be ignored.

The historical development of wastewater management has been characterised by efforts to solve mainly one problem at a time; sanitation during the first half of the 20th Century followed by eutrophication of receiving waters and, for the past 10 years or so, recycling of nutrients. After the Dublin Conference on Water and

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