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INTRODUCTION:

The lack of access to safe drinking water and hygienic sanitation is still a major health treat for many Africans. Especially in poor communities the situation is threatening as these vulnerable communities are often affected most by climate change since they lack the ability to cope or adapt to changes such as droughts, floods, conflicts, price fluctuation, etc (UNEP 2007, Chapter 7). In recent baseline studies conducted by TU/e students to assess the socio-economic status of people living in poor areas it was found that (Heijnen 2010, Balkema et al 2010). Their quality of life can be improved by investing in basic services such as hygienic sanitation to prevent diseases.

METHODS:

In previous research we calculated that the investment in wastewater treatment systems such as constructed wetlands at schools in Tanzania is not only needed from humanitarian point of view but is also paying itself back as the avoided health costs are high (NPV = 11,100,000 TSh. (8,880 US$), real IRR = 493% to be compare with the real ARI of 4%, and the Pay Back Period = 1 year (Balkema et al. 2010)). Other researchers report similar findings, for instance Hutton and Haller (2004) report that the total annual economic benefits of water and sanitation interventions in the East African region are estimated to be 72 US$ (2000) per person when realising access to water supply with disinfection at point of use and sanitation (Hutton and Haller (2004), p.34, p.46).The benefits are even higher if the nutrients in the wastewater are reused in agriculture. In cost benefit analysis of eco-sanitation projects in which wastewater sludge form urban area’s is transported to agriculture (Kuipers 2011, Drewko 2011).

Agricultural production in Africa is characterized by low productivity caused by a combination of endogenous and exogenous factors which include lack of adequate agricultural inputs such as nutrients in form of fertilizers and manure necessary for plant growth. Sub-Saharan Africa has the world's lowest level of mineral fertilizer use. It is estimated that Sub- Saharan Africa imports more than 90 percent of its agricultural fertilisers. Decline in soil fertility is reported as one of the major constraints hampering rural development in Tanzania (Ley *et al*., 2000). This has resulted in poverty, widespread of malnutrition and massive environmental degradation (Shepherd and Saule, 1998; Ley *et al*., 2000). Nutrients contained in treated wastewater can be used to fertilise cropland. Treated wastewater can safely be used for irrigation of crops, such as fodder grasses, vegetables, cereals, ornamental plants, trees and flowers, timber crops and fruit trees, as well as for aquaculture. Treated wastewater is often the only source of irrigation available. In very dry areas subsurface wetlands can be used to store water and prevent evaporation. Wastewater use for irrigation generates livelihoods for farmers, agricultural laborers, produce transporters, market brokers and produce vendors. In some countries, such as Mexico and China, it has been practiced for centuries (Shuval *et al.,* 1986).

The reuse of nutrients is also important for the development as it can improve the quality of life of vulnerable groups by improving agricultural practices helping to increase yield and therefore improving food security. Reuse of nutrients also helps in mitigating climate change as artificial fertiliser use can be diminished. Furthermore, in some cases biogas can be produced to replace fossil fuels or traditional fuels such as fire wood.

RESULTS:

In our research we identified several options for win win win wastewater treatment systems for different cases such as (3) domestic wastewater in crowded urban areas, (2) institutions such as schools, and (3) food industry. All treatment systems are based on treating wastewaster (eliminating pathogens, lowering oxygen demand, etc.) while conserving valuable resources (nutrients for fertilisation, water for irrigation, and biogas to replace fossil fuels or traditional fuels such as fire wood).

(1) Wastewater treatment for households: Eco Sanitation

In crowded urban areas nutrients may be abundant and even leading to eutrophication while in rural areas lack of nutrients are limiting agricultural production. If wastewater streams can be kept separated nutrients can be recovered undiluted and almost septic in the form of urine (Vleuten-Balkema 2003). Recent studies by Kuipers 2011and Drewko 2011 show that affordable logistics can be set up to return the urban nutrients to rural agriculture for fertilisation.

(2) Wastewater treatment for institutions: Constructed Wetlands at schools

Research has shown that constructed wetlands can form an affordable and reliable wastewater treatment for institutions that allows safe reuse of the effluent for agriculture (Balkema 2010, Ruijter 2008).

(3) Wastewater treatment for food industry: Banana Wine Production

To sustainably treat agro-process wastewaters with value-addition along the treatment chain, integration of anaerobic digestion with sludge processing into fertilizer and constructed wetlands is necessary to efficiently reduce pollutants to acceptable discharge standards while generating income from biogas and agricultural production. Therefore, integrated treatment systems consisting of Upward flow Anaerobic Sludge Blanket (UASB) reactor, and a constructed wetland will be operated for the treatment of banana wine effluents in Tanzania. The resultant nutrient-rich sludge shall be dried, processed and used as soil conditioner while the primary treated effluent will further be polished in subsurface flow constructed wetland before it is directed to irrigate crop land. The gas produced shall be used to replace fuel wood in the banana cooking processes of the winery plant thus reducing deforestation. This action shall also act as an incentive to the Banana Wine factory to treat its wastewater. Both cost benefit analysis and social benefit analysis of the process shall be evaluated and documented. The performance of the integrated bioprocess shall be evaluated based on reductions in COD, BOD, suspended solids, nutrients, sulphides, and bacteria according to standard methods (APHA, 1998).

DISCUSSION:

Currently, progress in increased access to safe drinking water and hygienic sanitation is hindered by the lack good governance, lack of knowledge dissemination, and lack of investment capital. While the reuse of nutrients is hindered by a lack of knowledge on best hygienic practices, lack of investment capital, lack of incentives to change habits, and absence of market regulations. Besides initiatives for more demonstration projects to learn and gather evidence on best practices, initiative on international level is needed to set priorities, mobilise investment capital, disseminate knowledge and regulate markets. Current global power relations have put climate change higher on the political agenda soil fertility, this is problematic since the loss of soil fertility is a major threat to food security for present and future generations. This indirectly leads to undervaluation of organic fertiliser and as such the drive to reuse valuable nutrients is lacking. Valuable resources containing nutrients may be used for other purposes such as energy production without returning nutrient rich sludges, seed cakes, or ashes to agricultural land. Misleading terms such as “agricultural waste” and “waste land” may be used to push for biofuel production while valuable resources for soil fertilisation and food security may be lost. As there is no waste in nature and land cannot be wasted if food since a scares resource. International knowledge institutes and policy makers on should solve this problem by gathering evidence and taking political responsibility.

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