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# Wastewater Management: An African Vetiver Technology

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*An urban wastewater drain. Photo: Effiom E. Oku / UNU-INRA*

## INTRODUCTION

Africa faces a big challenge of wastewater management. Annual deaths associated with wastewater and unimproved sanitation in the continent are among the highest in the world, ranging from 286 per 100,000 children under 5 years to 1,473 for some countries (UNDP, 2014). Wastewater is reported to contain hazardous elements, such as Cadmium (Cd), Arsenic (As), Copper (Cu), and Lead (Pb) (Barakat, 2011). These metals are known to cause serious health problems including reduced growth and development, cancer, organ and nervous system damage and in extreme cases, death.

This policy brief reveals a unique African bio-resource (*Chrysopogon nigritanus*) that could transform wastewater management in the continent, making it safe for discharge into water bodies, and for re-use in agriculture.

## CONTEXT

Industries are increasingly discharging untreated wastewater into natural water bodies. Worldwide, about 80%-90% of wastewater is discharged untreated into fresh water bodies (Corcoran et al., 2011). Despite health concerns, the use of wastewater for irrigation in urban agriculture, aquaculture and for domestic activities is growing in Africa and other developing countries. Similarly, wastewater from domestic activities and agrochemicals applied to cultivated fields flow as runoff into water bodies, contributing to the wastewater menace in Africa.

***A farmer irrigating food crops with wastewater. Photo: Effiom E. Oku / UNU-INRA***

## APPROACH

This study was conducted in Nigeria, using an African endemic Vetiver grass (*Chrysopogon nigritanus*) to treat wastewater. Effluents were collected from an abattoir, a quarry site, and from fertilizer and cassava processing companies. Untreated leachate from a public refuse dump, wastewater from urban drains and crude oil polluted water were also collected. Heavy metals detected in the wastewater were Cadmium (Cd), Lead (Pb), Zinc (Zn), Arsenic (As), Nickel (Ni), and Manganese (Mg). Other properties determined were Biological Oxygen Demand (BOD), pH, Nitrate (N) and Phosphate (P).

Vetiver plants were first raised hydroponically for 10 weeks to enable the roots and shoots to establish (Truong and Hart, 2001). The vetiver plants were then transferred into the wastewater for treatment. After treating the wastewater with the grass for 2, 4, and 6 days, water samples were collected for laboratory analyses. The levels for the heavy metals were compared with WHO / FAO / USEPA safe levels for wastewater before discharge or re-use.

## KEY FINDINGS

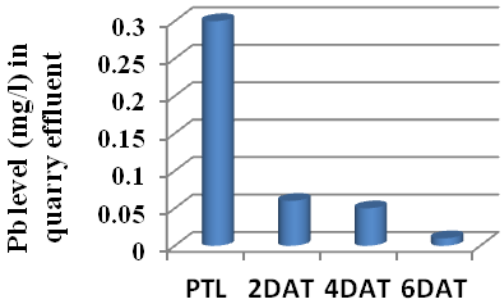
After 2 days treatment, the results showed that Lead (Pb) and Arsenic (As) were removed in the quarry effluent by 80 % and 55 %, respectively. Arsenic was completely removed from the effluent, after 4 days treatment. Similarly, Cadmium and Cyanide levels in fertilizer and cassava factory effluents were reduced from unsafe levels of 0.2 mg/l and 4.53 mg/l to safe levels of 0.01 and 0.20 mg/l, respectively, after 4 days treatment with the vetiver grass. In addition, nitrate and phosphate, which are major contaminants of aquatic resources, were also reduced to safe levels of less than 50 mg/l and 30 mg/l, respectively, after 4 days treatment.

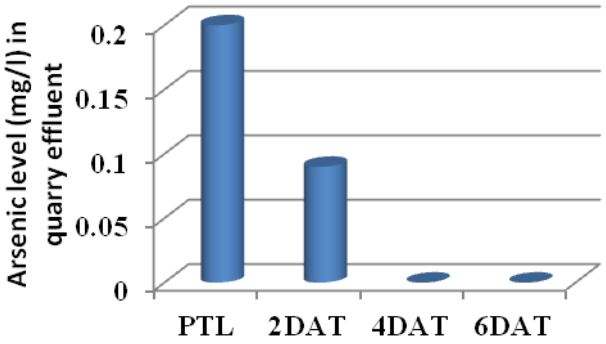
Pre-treatment contaminant levels of the wastewater metals had been found to be above the accepted tolerant limit of the WHO / FAO / USEPA. The African vetiver grass was effective in reducing these heavy metals in the wastewater to safe levels.

It is important to note that, unlike conventional systems, the energy required by this bio-engineering system was only sunlight to promote the growth of the vetiver plant. Africa can therefore rely on this bio-resource (*Chrysopogon nigritanus*) as a sustainable way of treating wastewater before discharge or re-use.

***Wastewater treatment with vetiver grass. Photo: Effiom E. Oku / UNU-INRA***

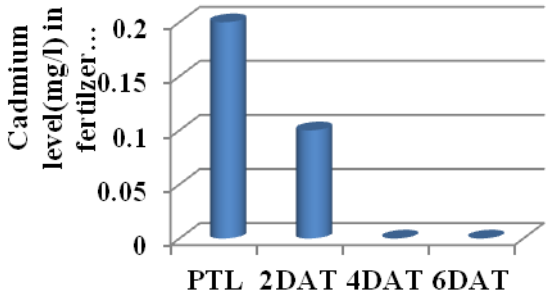
Figure 1, 2, 3, 4, 5 and 6 below show the removal rate of contaminants by the African Vetiver grass:

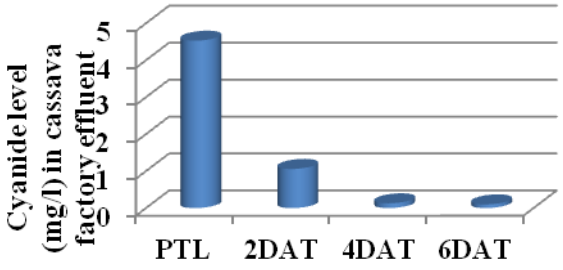



**PTL=pre-treatment level; DAT=days after treatment**

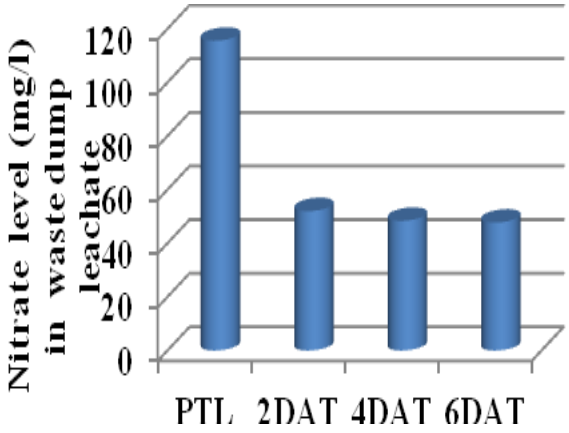
Figures 1 and 2: Pre and post-treatment levels of Lead (Pb) and Arsenic (As) of quarry effluent, using the African vetiver *spp*. for the post-treatment analyses.

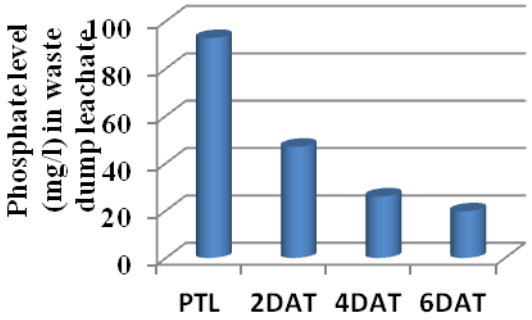



**PTL=pre-treatment level; DAT=days after treatment**

Figures 3 and 4: Pre and post treatment levels of Cadmium (Cd) and Cyanide (HCN) in fertilizer and cassava factory effluents, using the African Vetiver *spp.* for the post-treatment analyses.




**PTL=pre-treatment level; DAT=days after treatment**

Figures 5 and 6: Pre and post treatment levels of Nitrate (N) and Phosphate (P) in untreated public waste dumpsite effluent, using the African vetiver *spp*.for the post-treatment analyses.

## POLICY IMPLICATIONS

Continuous use of untreated wastewater for irrigation may increase outbreak of diseases related to the consumption of food crops irrigated with contaminated water. Farmers using the wastewater for irrigation can also develop skin diseases. The health risks posed by the contact and use of untreated wastewater can negatively affect productivity and economic development. It could also outstretch Government's budgets in its attempt to eradicate the diseases.

Furthermore, conflicts often arise between communities and industries as a result of pollution of land and water bodies with untreated effluents. This could also slow down economic activities and result in low productivity.

## POLICY OPTION

There is the need for a national policy in African countries to encourage wastewater treatment to internationally appropriate levels, before re-use. The vetiver technology could be adopted as this proved to be effective in wastewater treatment. Investment in this technology could help promote efficient wastewater management in Africa.

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**This Policy Brief is prepared from a UNU-INRA Working Paper entitled:**

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