PRINT: ISSN 0970-9274 ONLINE: 2456-6608
J Hum Ecol, 31(1): 47-52 (2010)
DOI: 10.31901/24566608.2010/31.01.06

Effect of Channelling Wastewater into Water Bodies: A Case Study of the Orogodo River in Agbor, Delta State

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KEYWORDS Wastewater. Orogodo River. Agbor. Channelling. Water Bodies. Delta State

ABSTRACT The rapid urbanisation, lack of financial means for adequate environmental protection has led to an increase in the rate of wastewater generation. This work is aimed at creating an awareness of the hazards caused by improper wastewater management on the environment and water bodies with the Orogodo River in Agbor, Delta State as a case study along with its economic implications. Proffer immediate and long term possible and feasible solutions out of the problem and create an exposition into the environmental and economic benefits of proper wastewater management.

INTRODUCTION

The Wikepedia (online encyclopaedia) defines wastewater as any water that has been adversely affected in quality by anthropogenic influence. From the standpoint of generation, APHA (1992) defined wastewater as a combination of the liquid or water carried wastes removed from residences, institutions and commercial and industrial establishments together with such ground water, surface water (such as from agriculture) and storm water that may be present, encompassing a wide range of potential contaminants and concentrations. In the most common usage, it refers to the municipal wastewater that contains a broad spectrum of contaminants resulting from the mixing of wastewaters from different sources. Untreated wastewater if discharged into any receiving body such as rivers, makes the water unfit for human consumption and may interrupt industrial use. Untreated wastewater makes water turbid and redcues light penetration and hence reduces the photosynthetic process of micro plants in the water body (Hodges 1973; Eckenfeldar 1978 and Ajayi and Osibanjo 1981).

Most of our water bodies have become polluted due to industrial growth; urbanization and man made problems mainly the result of population growth. Poor sanitation and contaminated drinking water arising from human activity and natural phenomena create serious problems in human health. The chief sources of water pollution are sewage and other waste, industrial effluents, agricultural discharges and industrial wastes from chemical industries, fossils fuel plants and nuclear power plants. They create a larger problem of water pollution rendering water no longer fit for drinking, agriculture and, as well as for aquatic life. More than 2.6 billion people- 40% of the world's population – lack basic sanitation facilities and over one billion people still use unsafe drinking water sources. As a result, thousands of children die everyday from diarrhoea and other water, sanitation and hygiene related diseases and many suffer and are weakened by illness (Pandey 2006). Also, erosion has led to extensive loss of top soil, large-scale gullying, and silting of ditches and rivers. The link between erosion, increasing fertilizer application, and loss of soil productivity is very direct in many countries (Elwell and Stocking 1982). Thereby causing heavy metal pollution on the environment and the local population, which has an effect on the economy as fishing and tourism sectors can be affected (TWAS Newsletter 2007).

The composition of wastewater varies widely depending on the type of activity producing the wastewater. Constituents of wastewater include water (> 95%) which is often added during flushing to carry the waste down a drain, pathogens such as bacteria, viruses, and parasitic worms; organic particles such as faeces, hairs, food, vomit, paper fibres, plant material, humus, etc; soluble organic material such as urea, fruit sugars, soluble proteins, drugs, pharmaceuticals, etc; inorganic particles such as sand, grit, metal particles, ceramics, etc; soluble inorganic material such as ammonia, road-salt, sea-salt, cyanide, etc;

animals such as protozoa, insects, arthropods, small fish, etc; macro-solids such as sanitary napkins, nappies/diapers, condoms, needles, children's toys, dead pets, body parts, etc; gases such as carbon dioxide, methane, etc; emulsions such as paints, adhesives, mayonnaise, hair colorants, emulsified oils, etc; toxins such as pesticides, poisons, herbicides, etc. (Rim-Rukeh 2009 and Wikepedia 2008).

Wastewater as a Valuable Energy Source

As stated by the Physiological Organization (2004), the new University of Toronto research says the energy stored in Toronto's municipal wastewater could be harnessed to run water treatment facilities and contribute power to the city grid, says new University of Toronto research. The research revealed that the wastewater contained enough organic material to potentially produce 113 megawatts of electricity or close to 990 million kilowatt hours a year. Also, the Sonoma County Water Agency says that recycled water is a new energy source that will become the source for heating and cooling. Already a pilot programme is been carried out whereby highly treated water is pumped from a treatment plant to heat and cool buildings with the additional promise of using the piped water to irrigate landscaping and vineyards. This is part of Sonoma County's broader goal of achieving "carbon-free" water by 2015 (Zito 2008).

In California, by injecting the effluent of wastewater into Geysers' steam reservoir has led to the production of about 85 additional megawatts. By injecting recycled water into the Geysers' steam reservoir, the City of Santa Rosa has found an environmentally sound discharge solution and is helping to promote green power production in California, thereby making the Santa Rosa Geysers Recharge Project (SRGRP), the world's highest-capacity geothermal power plant and also the world's largest wastewater-to-energy geothermal project and the ninth-largest wastewater-reuse project in the U.S (Leonard 2005). Also, in the region of Zeeuws-Vlaanderen in the Netherlands which generates more than 2.6 million gallons of municipal household wastewater every day, Terneuzen's local water purifiers have joined their efforts to sustainably control the regional water balance by using the wastewater in the production of steam used in the cooling towers at the site until it finally evaporates into the atmosphere. This effort results in 90 percent less energy use at this facility compared to desalinating this amount of sea water and a reduced need for water treatment chemicals. This has also lead to reduced intake of fresh surface water by 2.5 million m3 annually, decreased effluent discharge to the river as three million tons of water per year that was previously discharged into the North Sea after one use is now used an additional two times and 65% reduction in energy use compared to the original operation. The reduced energy use is the equivalent of lowering carbon dioxide emissions by 60,000 tons per year (The European business network for CSR 2007).

Wastewater Reuse in Agriculture

The use of urban wastewater in agriculture is a centuries-old practice that is receiving renewed attention with the increasing scarcity of fresh water resources in many arid and semi-arid regions of the world. Driven by rapid urbanization and growing wastewater volumes, wastewater is widely used as a low-cost alternative to conventional irrigation water: it supports livelihoods and generates considerable value in urban and peri-urban agriculture despite the associated health and environmental risks (Scott et al. 2004). The City of Arcata, California uses sewage that has been passed through primary treatment to supply water to marshes and ponds, where natural microbial action and plant growth purify the water further and remove nutrient. Also, in the early 1970s, Chicago developed a plan for using some of its sludge to fertilize 11, 000 acres of formerly strip-mined land during land reclamation, thereby solving several environmental problems at once (Montgomery 2006).

Considering the rapid urbanisation, lack of financial means for adequate environmental protection along with the problem of local freshwater scarcity, increasing polluting streams and steeply increasing food requirements in and around urban centres, it is important to come to a jointly agreed approach in tackling this problem. It is suggested to study and design the agricultural use of treated wastewater as part of a water chain approach, which allows linking the different issues, the domain of different disciplines, in a logical and stepwise framework (Huibers and Van Lier 2005).

According to the International Water Management Institute (IWMI) research in Pakistan, Ghana, Vietnam and Mexico which examined both positive and negative impacts of wastewater reuse for agriculture. It stated that the positive effects of waste water irrigation include the conservation of water, low-cost method for sanitary disposal of municipal wastewater provides a reliable water supply to farmer, increases crop yield, conserves nutrients thereby reducing the need for artificial fertilizer; reduces pollution of rivers, canals and other surface water resources. They also pointed out some potential negative effects such as health risks for irrigators and communities with prolonged contact with treated wastewater and consumers of vegetables irrigated with wastewater contamination of ground water, creation of habitat for disease vectors and build up of chemical pollutants in the soil (heavy metals). Not ignorant of the health hazards associated with wastewater irrigation, the IWMI's identified several simple practices that could reduce health risks to farmers and the community where domestic wastewater is used for irrigation. These practices include: wearing shoes and gloves while working in wastewater irrigated fields, regular treatment of farmers and their families with antihelmintic drugs to prevent worm infections, crop restrictions in wastewater irrigated fields and better information on hygiene behaviour and risk of wastewater irrigation for farmers.

Wastewater and Global Warming

The lack of proper wastewater treatment results in production of CO_2 and CH_4 without the opportunity for carbon sequestration and energy recovery, with deleterious effects for global warming. Without extending wastewater treatment to all urban areas worldwide, CO_2 and CH_4 emissions associated with wastewater discharges could reach the equivalent of 3.13·105 tCO2·d-1 in 2025, with even more dramatic impact in the short-term (Rosso and Stenstrom 2007; Wikepedia 2008).

Although Government at various levels in Nigeria, and through its various programmes and agencies, has made it a priority in providing portable water for its urban and rural populace through the sinking/drilling borehole water, there is need to address the fate of the water generated after it has met its primary purpose of household use; to know if it is contributing to the environmental hazards faced by man and various habitats. Currently, wastewater management is been perceived as the channelling of wastewater to their drainage points which are mainly water bodies and virtually little or nothing is been carried out to check the pollution load carried by the wastewater generated, and the environmental and health hazards created by wastewater. This work is therefore aimed at creating an awareness of the hazards caused by improper wastewater management on the environment, proffer possible and feasible solutions out of the problem and create an exposition into the benefits of proper wastewater management.

OBSERVATIONS AND DISCUSSION

Orogodo river is located at $6^1/_4$ N^0 $6^1/_4$ E^0 (Egun 2007) and is surrounded on both sided by the sloppy terrain of the Agbor metropolis. The river serves as the drainage point for all run off wastewater produced industrially or domestically within the Agbor metropolis and beyond as majority of the drainage channels constructed by the State and Local Government within the Agbor metropolis and surrounding villages, aimed at controlling flooding and checking erosion are channelled directly into the river at various points along the river length.

High economic activities taking place continuously on the water front ranging from car wash, washing of rugs, livestock markets, a major market known as the Agbor main market (which is located about 400 metres from the water front) and other industrial/ economic activities taking place at various locations within the Agbor metropolis such as laundry services, restaurants, household generated wastewater, water from food processing such as cassava fermentation, and vehicle servicing shops has contributed significantly to the high level of pollution experienced by the river. Also, due to the sanitation crisis which is particularly severe in Africa, where 6 out of 10 people do not even have a proper toilet, a factor according to the World Health Organization report, contributes to the transfer of bacteria, viruses and parasites found in human excreta which contaminate water resources, soil and food (Watchtower 2009). It is therefore not uncommon to see human faeces deposited directly or indirectly at various points along the water front from the rural areas were it is more prevalent down to the Agbor metropolis. The Benin – Asaba express way crossing the river with its drainage system emptying into the river, the river faces water pollution from highway runoff wastewater, whose most common contaminants are heavy metals particularly: lead, zinc, iron, chromium, cadmium, nickel, and copper, that result from the ordinary wear of brakes, tires, and other vehicle parts, inorganic salts, aromatic hydrocarbons, and suspended solids that accumulate on the road surface as a result of regular highway operation and maintenance activities. Also, the slope created by road cut in the construction of the high way has lost its stabilizing material at various points, thereby causing surface erosion.

Economic Impacts

- The river which was previously used for carrying out fishing activities is no longer used due to the water pollution leading to the silting of water body thereby reducing the size of the water front, depth and volume. Thereby eliminating one aspect of agriculture for which the Ika people are known for.
- *Recreational Activities:* The river, which used to serve as a recreation spot for various water games ranging from diving to canoeing, has been grounded due to the current state of the river.
- *Health:* With the current state of the river due to pollution, especially within the Agbor metropolis, the Orogodo River has lost its true definition as a fresh water body and can be referred to as a wastewater body as its water is no longer suitable for household use but rather serves as a breeding ground for bacteria, viruses and parasites.
- *Environment:* The enrichment of the river by nutrients, especially compounds of nitrogen and/or phosphorus, present in the wastewater discharged on to the river and whose rate of generation in on the increase has led to the distortion of the aquatic habitat of the river which is gradually shifting from a fresh water body to a swamp due to the continuous deposit of silt and the accelerated growth of algae and higher forms of plant life to produce an undesirable disturbance to the balance of organisms present in the water and to the quality of the water, it grass. Also, typical of every river having its own unique serenity which in most cases serves as tourist attraction e.g. the Ethiope River in Delta State, the Orogodo River has lost hers.

RECOMMENDATIONS

The challenges currently facing the Orogodo River is not peculiar to the water body alone as virtually all water bodies in the State are currently faced with these challenges at various points along the river length. Therefore, there is need to implement projects or programmes that will help in checking and controlling these environmental hazards on short and long term basis. These control measures include

1. Diversion of run off wastewater from the drainages by considering the use retention ponds or lagoons for runoff/waste collection and establishment of wastewater treatment facilities within the States' major urban towns and cities by the Government or in partnership with the private sector waste materials produced in these towns and their surrounding settlements.
2. Carrying out of massive awareness campaign on the environmental hazards of wastewater through the various forms of media. This will help in enlightening the public on their individual roles as regarding wastewater generation and constituents. This awareness will entail the provision of information to the public about proper disposal of certain substances and materials (such as petrochemical products, whose general mode of disposal is through the wastewater drainage system) and how these substances affect the ecosystem. As this will not only lower the toxic load of the wastewater generated over time, it will also facilitate easy processing of the wastewater.
3. Controlling surface water pollution from livestock. By fencing animals out of surface water areas. Maintain proper areas for runoff disposal. Prevent overgrazing of pasture land Dispose of runoff on grassed areas with good infiltration and percolation rates. These areas can be cropped but should not be allowed to stand without a cover crop during wet months.
4. Regulate manure application to cropland especially on sloping land susceptible to runoff Montgomery (2006). Reduction of fertilizer application to the minimum needed, perhaps coupled with the use of slow – release fertilizers would minimize the harmful effects. Nitrates could alternatively be supplied by the periodic planting of legumes; on

the roots of which grow bacteria that fix nitrogen in the soil. This practice reduces the need to apply soluble synthetic fertilizers.

5. Encourage the practice of contour cropping on the vegetative slopes where agricultural practices are been carried out. The link between erosion, increasing fertilizer application, and loss of soil productivity is very direct in many countries (Andreoli 1993). Therefore ploughing rows parallel to the contours of the slopes and perpendicular to the direction of water flow creates a ridged land surface that slows down the speed of surface run off water and reduces soil erosion. This will lead to increase infiltration and enhance water conservation as well as soil conservation. Increased water retention from contour ploughing in Texas has been shown to increase cotton yield by 25 percent (Montgomery 2006).
6. Stabilization of exposed near surface soil by planting ground covers or other fast growing materials with sturdy root system preferably and maintaining grass buffer areas near surface water. Also retaining walls or other stabilization structures should be built against the slope, especially slope created by road cut during the construction of highways as this will help in holding the soil together.

Currently, as the State Government is drawing out plans for development for its urban centres, there is need for the incorporation of proper wastewater management strategies and policies into these plans to take care of the high rate of wastewater production due to urbanization. Some of these policies are stated in the Hyderabad Declaration on Wastewater Use in Agriculture on the 14 November, 2002 (Scott et al. 2004). The declaration states that:

1. Rapid urbanisation places immense pressure on the world's fragile and dwindling fresh water resources and overburdened sanitation systems, leading to environmental degradation. We as water, health, environment, agriculture, and aquaculture researchers and practitioners from 27 institutions and representing experiences in wastewater management from 18 countries recognise that:

1.1 Wastewater (raw, diluted or treated) is a resource of increasing global importance, particularly in urban and peri-urban agriculture

1.2 With proper management, wastewater use contributes significantly to sustaining livelihoods, food security and the quality of the environment

1.3 Without proper management, wastewater use poses serious risks to human health and the environment.

2. We declare that in order to enhance the positive outcomes while minimising the risks of wastewater use, there exist feasible and sound measures that need to be applied. These measures include:

2.1 Cost-effective and appropriate treatment suitable for wastewater, supported by guidelines and their application

2.2 Where wastewater is insufficiently treated, until treatment becomes feasible:
   – Development and application of guidelines for untreated wastewater use to safeguard livelihoods, public health and the environment
   – Application of appropriate irrigation, agricultural, post-harvest, education and public health practices that limit risks to farming communities, vendors, and consumers.

2.3 Health, agriculture and environmental quality guidelines that are linked and implemented in a step-wise approach.

2.4 Reduction at source of toxic contaminants in wastewater.

We also declare that:

2.5 Knowledge needs should be addressed through research to support the measures outlined above

2.6 Institutional coordination and integration together with increased financial allocations are required.

3. Therefore, we strongly urge policy-makers and authorities in the fields of water, agriculture, aquaculture, health, environment and urban planning, as well as donors and the private sector to safeguard and strengthen livelihoods and food security, mitigate health and environmental risks and conserve water resources by confronting the realities of wastewater use in agriculture through the adoption of appropriate policies and the commitment of financial resources for policy implementation.

Also, as an advocate of quality research for technological advancement, establishment and proper funding of research institutes/ centres by the Delta State Government, researching into the various ways of treatment and handling of wastewater especially in the area of its use in agriculture for irrigation of food crops and determining which of the crops produced within the locality is the wastewater generated from that locality suitable for, thereby increasing local content production. Similar researches have been carried out already in other countries, which include California, USA; Mezquital valley, Mexico; Calcutta, India and Tunisia (Pescod 1992).

CONCULSION

In conclusion, proper addressing of the problems/ challenges faced by water bodies from wastewater channelling, will not only lead to the restoration of aquatic habitats in the State, but will also restore fishing, recreational and other water activities and boast food production thus contributing to the economy. The establishment of the wastewater treatment plants will create jobs for various levels of manpower (skilled and unskilled). As the State seeks active partnership with private investors in order to harness her abundant human and material resources and diversify its economy, wastewater management should be seen as an industry worth investing in as it has the potentials of complementing every sector of the economy.

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