Liquid Manna? Treating Urban Wastewater for Local Gardening

A flower grower uses treated wastewater. (IDRC Photo: Coumba Sylla)

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Like urban centres all across Africa, the population of metropolitan Dakar in Senegal has mushroomed over the past three decades. As more and more people crowd into the city — an average of 120,000 per year — the demand for urban services has also increased, outstripping the city's capacity to build the infrastructure necessary to meet the needs of the new arrivals.

Moreover, in the burgeoning metropolis, the demand for food is constantly increasing. As a result, urban and peri-urban agriculture has been on the rise and is now estimated to provide 60% (some 39,000 tons annually) of Dakar's consumption of vegetables.

However, city farming is hampered by the pressure urban growth is putting on water supplies, particularly on groundwater reserves. In fact, growers in and around Dakar are finding it almost impossible to obtain clean water to irrigate their crops that doesn't cost a fortune.

Wastewater: liquid manna?

Tap water from the city system is expensive and hard to come by. As a result, growers are turning to another source of "liquid manna." They are watering their crops with domestic wastewater which is readily available and costs nothing. According to Seydou Niang, a hydrobiologist and environmentalist at the Institut fondamental d'Afrique noire (IFAN) of Dakar's Université Cheikh Anta Diop, "Dakar today is dumping about 200,000 m^3 of wastewater a day," double the volume produced less than 15 years ago.

Reusing this large quantity of wastewater could help Senegal address its water supply problems, but the capacity of Dakar's water treatment systems has not kept pace with the city's growth. This means urban farmers are often watering crops with untreated wastewater which can carry disease, resulting in harmful consequences for both growers and the consumers of their produce.

Water treatment systems

What, then, is the best way to treat wastewater so it can be safely used in urban and peri-urban market gardening and thereby help to feed the city's poor?

A multidisciplinary research team, composed of biologists, urban planners, engineers and others, is doing research to address this question with support from the International Development Research Centre (IDRC), the Canadian International Development Agency (CIDA) and the United Nations Environment Programme (UNEP).

Research is being conducted as part of a broader project, Urban Environment Sustainable Improvement Process (PADE), launched in 1991 by the Relay for Participatory Urban Development (RUP) of the non-governmental organization (NGO) Enda Third World (Environmental Development Action in the Third World).

Research is currently underway in Castors and Diokoul, two poor neighbourhoods of Rufisque, an old town on the outskirts of Dakar. With the participation of local residents, Enda-RUP built two wastewater treatment stations under the PADE program, in 1994 and 1995.

"Before, we had no proper sewage system and people were forced to empty their septic tanks two or three times a month," according to Marième Diouf, a member of the research team and president of a women's GIE (*groupement d'intérêt économique*, a type of cooperative) in Castors. At a cost of about CA$100 per operation, this service was more than the people of Castors could afford.

"Some of them would just wait until dark and then empty their sewage into the street," says Diouf. The unsanitary conditions this practice created meant that residents faced high risks of illnesses such as diarrhea, dysentery, and skin ailments.

Purifying water using an aquatic plant

Conventional sewage treatment is beyond the means of the municipality, so researchers have been experimenting with a biological method that involves lagoons and the use of an aquatic plant, *pistia stratiotes*, otherwise known as water lettuce.

Water lettuce is a tropical plant that grows easily in broad, shallow, open-air wastewater ponds, obtaining nutrients from the wastewater's phosphorus and nitrogen. The roots of the plant trap suspended solids and create an ideal environment for the growth of microscopic organisms that feed off the organic materials present in the wastewater. The water that results from this process can be more safely reused for agriculture, flower growing, composting of household refuse, or for watering tree nurseries. [See related sidebar: A Biological Approach to Treating Water]

Research results

The first phase of the research project, which ran from 1999 to 2002, produced informative results. Researchers found that some vegetables irrigated with wastewater produced higher yields, compared to plants irrigated with tap water and fed fertilizers. For example, cabbages watered with treated wastewater are yielding 47.8 tons a year per hectare, compared with 32.1 tons a year per hectare in fields where tap water and fertilizers are used, according to Enda-RUP. (In Senegal, it is possible to harvest crops multiple times on the same hectare.)

Moreover, research has shown that malaria-carrying mosquitoes cannot breed in the ponds where water is treated.

However, researchers also found some of their test plants were dying because they could not survive in the basins. Other plants demonstrated an incomplete filtering capacity and lab tests found the treated water contained toxic residues in excess of the standards set by the World Health Organization (WHO).

In terms of the testing, while samples were previously sent abroad for laboratory analysis, IFAN has been performing this analysis in-house since 2001. As a result of the project, IFAN now has a wastewater treatment laboratory, equipped with up-to-date instruments. It will soon also have an experimental station with 20 basins. Moreover, using the IFAN laboratory, Niang has already helped to train sanitary engineers and doctoral candidates in biology.

New directions

A second phase of research, running from 2003 to 2005, seeks to produce water that can be reused in market gardening, in accordance with WHO recommendations, while seeking ways to make use of treatment by-products. For example, the plants, once dried, could be used as a high-protein source of fodder for livestock.

Solving these research problems represents a “daily struggle” says Niang. Nevertheless, one thing is absolutely certain according to this researcher: the treatment system has great potential because it is “efficient and suitable to the socioeconomic, cultural, and environmental context” of Senegal.

“Instead of importing technologies, it is better to import the methodologies and adapt them to our living conditions, our climate, and our customs,” he says.

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L'épuration extensive des eaux usées pour leur réutilisation dans l'agriculture urbaine : des technologies appropriées en zone sahélienne pour la lutte contre la pauvreté at http://www.enda.sn/rup/documents/crdi/resume.htm

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Sidebar

A Biological Approach to Treating Water

The wastewater treatment stations in Rufisque use lagoons and aquatic plants for wastewater treatment — an approach that is affordable and effective. A system has been installed that recovers wastewater from the showers, kitchens and washing facilities of individual households. Wastewater is first filtered for greases. A settling tank then captures solids and sand before the wastewater moves into the main lines. The sewer lines were built thanks to a community clean-up fund for poor neighbourhoods financed by community contributions and other financing obtained by Enda-RUP. Solids are collected twice yearly from each household's settling tank, as part of a maintenance service that costs about CA$12.00 per household per year.

Once in the main sewer lines, gravity causes wastewater to flow to the treatment stations several kilometres away. There, a settling and digesting basin is followed by four treatment lagoons planted with the water reed, *typha australis*, which can withstand the salt-laden winds from the sea. Lagoons in the water treatment station are also planted with *pistia stratiotes*, otherwise known as water lettuce. The water lettuce naturally removes impurities from the water.

The local community is involved in running the system through management committees, as well as by participating in planning, monitoring, and evaluation. "By involving the communities, we have been able to come up with some alternatives," says Siny Sène, president of a GIE at Diokoul and another member of the multidisciplinary team.

"People have really pitched in, giving physical, financial, and moral support to the program," he adds. Associations, neighbourhood representatives, women's groups, and health committees have all played a part.