ECOLOGICAL SANITATION AND URBAN SUSTAINABILITY

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A public health revolution

Ecological sanitation could be the beginning of a new public health revolution. Ecological sanitation is an eco-system approach to dealing with human excreta and other solids and liquids that we now try to get rid of through disposal. Ecological toilets separate urine and faeces and further dry the faeces over time. This process destroys pathogens in the faeces before they are released back into the environment and recovers the nutrients and organic matter from both the urine and faeces and returns them to soil and plants.

During the 20th Century we have witnessed several public health revolutions including universal childhood immunizations, the eradication of smallpox, improved water supplies, the green revolution with its improved food yields, and the expansion of primary health care. The one public health problem that has proved almost intractable this past decade has been a lack of sanitation for almost half of the population of the world. Obstacles to universal sanitation have been technologies requiring water, high cost relative to local resources, and a focus by donors on providing clean water supplies. Ecological sanitation is overcoming obstacles of the past by requiring no water, its relative simplicity of design and low cost, and the attractive feature for many cultures of being able to use the collected urine and sanitized faeces for agricultural purposes. We can now expect a rapid expansion of this new way of thinking, saving millions of lives annually and reducing morbidity from excreta-related diseases.

How quickly and effectively this revolution will occur will depend largely upon how well we plan for the rapid urban growth that is predicted to occur in the next fifty years. This paper presents a vision of how ecological sanitation should fit into urban growth, how urban planning should plan for recycling nutrients in human excreta, as well as the other “rest-products” that accumulate in urban settings. It introduces the concept of “eco-stations,” places where all rest-products are recycled and turned into products useful again to society. The recycling of human urine and faeces could be a large part of that system. This paper builds upon the vision first presented in the book Ecological Sanitation by Esrey et. al. (1998).

Urban growth and sustainability

The overriding priority for the 21st Century will be to ensure the sustainability of cities. Today half the approximately six billion people in the world are living in urban areas. In 2020, UNFPA estimates that 4.2 billion will be in urban areas, and in 2050 two-thirds of the world’s nine billion people will be urban dwellers, or approximately six billion.

Today there are 19 mega-cities in the world, cities with more than 10 million people, and 15 of them are in developing countries. By 2015, there will be 23 mega-cities in the world, and 19 of those will be in developing countries. Rapid growth is also expected in smaller cities ranging from 250,000 to one million. The combined annual growth of such cities totals more than 28 million. East Asia’s urban population is expected to more than double in the next two decades from 568 million in 1996 to more than one billion in 2020.

Two billion of the three billion urban dwellers in the world today live in less developed countries. The World Bank estimates that in 1994 nearly a half billion urban dwellers, or 25 percent of the less developed world's urban population, did not have access to even the simplest latrines. If that trend continues, in 2020, 700 million urban people will not have any sanitation and, in 2050, that figure will be one billion. This simple mathematics does not take into account many intervening factors that might occur to alter this trend either up or down, but it roughly points out that cities may be facing a large public health crisis.

Globally, in the year 2000, over one billion people did not have adequate water supply, and 2.4 billion did not have adequate sanitation. The challenge in East Asia alone will be to provide water and sanitation to an additional half-billion urban dwellers in the next twenty years. Globally the challenge is to provide sanitation to 3.1 billion people over the next twenty years, 700 million of whom will be in urban areas.

In the last decade 747 million additional people gained access to sanitation facilities globally. That works out to be roughly 205,000 people per day. WHO/UNICEF predict that to achieve 2015 targets in Africa, Asia and Latin America for sanitation, 384,000 people will need to be provided sanitation every day for the next 15 years, nearly double the rate of the last decade.

The challenge, therefore, is laid out squarely before us. Efforts in sanitation need to be doubled over the next 15 to 18 years, and we need to increasingly turn our attention to the unserved in urban areas where crowding and lack of sanitation could create high risk environments for health. Ecological toilets would be far quicker, cheaper and easier to build than septic or sewerage systems to achieve that kind of coverage in both urban and rural areas.

The need for recycling

In total, the world's population discards about one billion tons of domestic waste each year. That figure doubles when industrial solid wastes are added. China alone is estimated to have produced 800 million tons of industrial and domestic solid waste during 1995.

Cities produce 75 percent of all wastes produced on earth, and between one third and one half of urban trash goes uncollected. Much of it is thrown into streets, vacant lots and canals. Trash provides the breeding grounds for mosquitoes and rats that carry diseases. During the rainy season, storm drains and canals often clog with garbage, causing flooding, and pit toilets and septic tanks overflow, mixing excreta with drinking water. All of these are very dangerous events for the spread of diarrheal diseases. Whatever trash is collected ends up in huge mounds of hazardous waste on the outskirts of cities.

A large part of the reason why cities are growing so rapidly, why a quarter of the urban dwellers lack sanitation, and why up to half of all urban garbage goes uncollected is because half the world's population subsists on less than US$2 per day and the number and proportion of those living in extreme poverty are rising. Rural poverty fuels urban migration. Sanitation is low in the urban poor's list of priorities for survival, and city governments generally do not supply services for those who cannot pay. As a result, today 25-30 percent of the world's urban population lives in deplorably inadequate housing, squatter settlements, or in the streets where they lack sanitation, solid waste disposal and clean water supply.

Not only do garbage and lack of toilets in urban areas present a health risk, but in cities all over the world, in developed and developing countries alike, very poor urban people, and often children, make a living rummaging through waste piles and garbage containers, exposing themselves to even more health risks. Examples are the 30,000 Zabaleen of Cairo, a portion of the approximately five million of gypsies of Eastern Europe, the thousands of Travellers in England and Ireland, and tens of thousands of urban poor of Manila, Bombay and Kathmandu. Globally, garbage pickers probably total hundreds of thousands of people, or perhaps even more. In many cities around the world, garbage pickers live on dump sites and are exposed to the dangerous fumes that rise from them. They often burn the piles to get the metals buried under, releasing fumes of noxious smoke into far-off areas. They are exposed to dangerous medical wastes and sharp objects as well as germs. In 2000, garbage pickers living on the edge of a garbage pile in Manila were buried alive when the pile exploded and slid in heavy rains.

With the rapid growth of cities that is foreseen, these conditions will only worsen in the future if we do not act now.

While we observe the problem, we ignore the solution. Increasingly there is a call for using urban organic wastes for urban and rural agriculture. Farmers in some parts of the world bribe garbage trucks headed for landfills to offload their garbage onto the edges of fields, where they compost them for about two weeks and then dig them into the soils. Even though this practice is illegal most everywhere, because of the health hazards involved, it is an increasingly seen phenomenon. It is only logical that the organic wastes from food produced in rural areas to feed cities should be returned to the rural areas to replenish the soils. It is also logical that urban areas should produce some of the their own food, and with increasing urbanization, will probably need to.

The "eco-station" vision

And so, we have an increasingly evolving situation of rapidly growing cities, millions of urban dwellers without sanitary toilets, mountains of garbage piled on the outskirts of cities, uncollected garbage in cities creating health hazards, poor people picking through garbage for recycling, and various efforts, sometimes unsafe, to reuse organic garbage in agriculture. As cities grow, the need to address this situation also grows.

Surely, the sustainability of cities will rest upon a foundation of recycling all products in a systemic and healthful way. An emphasis upon recycling will not only offer clean and healthy environments but will also provide new employment opportunities and will help to develop a new value system for our increasingly crowded way of life.

The rapid growth of cities means that we must be planning for sanitation that includes the recycling of human excreta and all other waste products from households, such as organic kitchen waste, paper, cardboard, wood, plastic, glass and metals. We must think in terms of neither landfills nor garbage mounds being a part of cities of the future, nor should we think of exporting our garbage and human excreta elsewhere! We need to deal with our solid wastes where we create them, and we must also solve the problem of the removal of human excreta from the home and neighborhood environment when we adopt ecological toilets.

City planners need to plan now for neighborhood recycling stations, which we can call "eco-stations." The task of the eco-station is to recycle all wastes, which we can call "rest-products," generated by communities. The output of eco-stations can be

compost for urban and rural agriculture; electricity; crushed glass for road base; steel, aluminum, and plastics ready to make new products; refurbished bicycles, automobiles and small household appliances. The objective would be zero emission and zero landfilling. Communities would urge citizens to buy only products that can be recycled, and city governments could give tax advantages and other incentives to shops selling only products that can be recycled.

Products of ecological toilets, the urine and sanitized feaces, could be collected house-to-house, along with other household garbage and taken to the eco-station. Urine, which requires no further processing before collection, could be collected weekly. Dried feces would be collected every six months, allowing time for complete desiccation and destruction of pathogens. Urine, after minimal further processing, could be sold for fertilizer, while the dried fecal products could be further processed through composting with other organic products and then also sold for fertilizer and soil conditioners. There are many areas in and around cities where organic fertilizer and compost can be used: for urban and rural agriculture; for the creation of parks and golf courses; for wasteland areas that could be rejuvenated with a good supply of topsoil, such as old quarries and badly eroded areas; and for roof-top gardens to lower urban temperatures. The eco-san approach should be viewed as a means for continually creating products that enrich soils for production of healthier urban environments. Eco-sanitation completes the nutrient cycle by closing the loop: from production, to consumption or use, to rest product, back to nutrient or raw material.

Eco-stations can be run by municipalities, by user cooperatives or by private enterprise. They can be labor intensive or highly mechanized. The possibilities for private businesses are fantastic. With an estimated 1 billion tons of domestic garbage generated worldwide every year and 300 million tons of human faeces, there is no shortage of materials. These figures will only go up with the population growth expected over the next 50 years.

Labor-intensive eco-stations would be preferable in areas with high unemployment or where there are a considerable number of people already having informal recycling businesses, such as the garbage pickers mentioned earlier. At the global level, an estimated 120 million people are unemployed and 700 million are classified as "underemployed," working long hours but not earning enough to cover their basic needs. China estimates that each year for the next 20 years China will need to find work for 12 million people. Today an estimated 200 million people are on the move, surplus laborers looking for unskilled work. Urban poverty in less developed countries is high and growing rapidly. Eco-stations, one for every 20,000 people in urban areas, could provide a considerable number of new jobs. For the tens of thousands of people around the world already working informally as garbage pickers and recyclers, eco-stations could formalize this sector, provide safe working conditions, decent pay, job security, and give dignity to people who would be providing an important public service.

We should begin today by creating the first pilot eco-stations in towns and small cities. Universities and research institutes should take up the challenge of designing these stations with support from local municipalities. By starting now, we can prepare for the inevitable explosion of urban population in the next five decades.

Examples of eco-stations

Fortunately some research and development on municipal recycling of all garbage is already taking place and is in operation. One Australian company is operating a

mechanized plant in the city of Wollongong that separates out metals and plastic and turns the remaining garbage into electricity. The plant at full capacity will process up to 150,000 tons of household rubbish annually and produce enough electricity for approximately 24,000 households. Operating costs at Wollongong are between $50 and $100 per ton. Revenues come from a contract with the city of Wollongong (50%), from electricity sales (40%) and from recycling sales (10%). This company already plans to expand. It is in discussion with five other Australian cities and twenty-four cities internationally on building plants to serve their needs. The company claims that these plants operate best in developing countries where waste-processing fees are very low, but energy prices are high. The company claims to have overcome the problem of many other garbage-to-energy operations, the production of dioxins. The gas emissions from burning the garbage are burned in a sealed chamber and the energy released is used to create power, keeping dioxin emissions far below European standards. In addition to this Australian company, there are approximately 120 garbage-to-electricity plants in North America.

A second promising technology for dealing with urban garbage is vermiculture, or worm culture. Another Australian company converts organic waste into fertile soil for agriculture. The worms can consume anything that was once alive and produce fertile humus. This company has developed a technology that can convert between 5 and 1000 tons a week, or 52,000 tons per year. They are now completing trials on conversion of high volumes of paper and plasticised-paper liquid containers. After only three years of operation the company has won several prestigious Australian awards. A quick perusal of internet websites on vermiculture indicates that there are several such facilities around the world in many countries.

Both of these technologies offer environment-friendly solutions to a global problem. Both produce good soils for agricultural land remediation, mine site rehabilitation, saline soil treatment and reforestation.

Conclusion

Eco-stations help us to avoid the problems of landfills and water pollution from sewage treatment. Landfills are environmentally unfriendly. They mix decaying biomass with a mixture of chemicals, creating a toxic time bomb. Sewage treatment plants produce large amounts of sludge that needs to be disposed of and often discharge partially treated water into lakes, rivers and oceans, polluting them. Both of these Australian examples, on the other hand, not only eliminate these problems, but also provide substantial greenhouse gas abatement due to reductions in methane generation from waste and the offset of the use of fossil fuels for electricity generation.

We could also expect a reduction in the diseases related to uncollected garbage standing in the environment, such as diarrheal diseases that occur during rainy seasons when drainage canals, clogged with garbage, overflow into streets, flood urban latrines and mix with drinking water pipes, and in the diseases borne by mosquitoes that breed in standing garbage, such as dengue fever and malaria. Perhaps also the use of urine and compost for fertilizer will replace some of the artificial fertilizers that pollute our water and perhaps affect our physiology.

Eco-stations can the next step in ecological sanitation. They will contribute to urban sustainability, and they will bring a return to natural cycles of the earth and help us to live once again in harmony with the natural environment.

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