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John Briscoe and Andrew Steer

New Approaches to Sanitation—A Process of Structural Learning

Prompted by the paper by Paul Appasamy and Jan Lundqvist on *Water Supply and Waste Disposal Strategies for Madras* and the paper by Janusz Niemczynowicz on *New Aspects of Sewerage and Water Technology*.
It draws on ongoing work supported by the World Bank, UNDP and developing country governments and NGOs to find solutions to urban environmental problems.

Managing wastes in urban areas is one of the most important and difficult environ-mental challenges for the coming decades. Even today, the unmet demand for sanitation services in developing countries is huge: 300 million urban residents have no access to sanitation facilities, and only a miniscule (less than 2% in Latin America) of sewage is treated. On top of this backlog, it is likely that urban populations in developing countries will almost triple in the next 40 years, while rural populations will rise only 10%, and industrial output and energy consumption will quintuple. The paper by Appasamy and Lundqvist provides a graphic illustration of the nexus of water supply and sanitation problems for the Indian city of Madras (1).

Conventional approaches to managing human waste—flush toilets with conventional sewers and treatment, financed and managed by the public sector—are clearly not adequate to the challenge. As Niemczynowicz points out, new approaches are urgently needed (2). Fortunately, there is a wide array of innovative approaches being explored in many countries around the

Box 1. The "condominial" System in Northeast Brazil

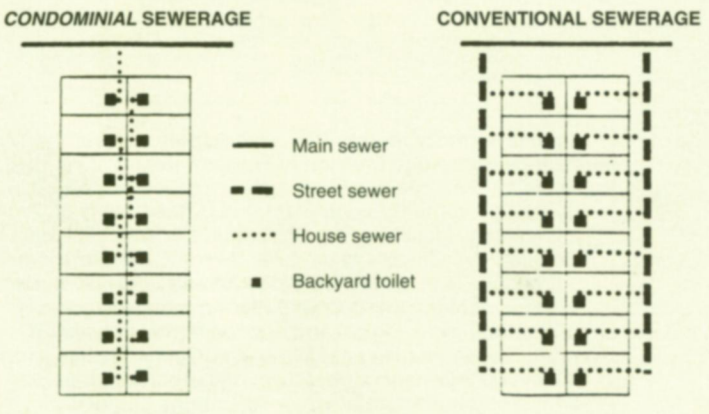
The "condominial" system provides a graphic illustration of the important relationship between institutional arrangements and wastewater collection and treatment technology. This system is the brain-child of Jose Carlos de Melo, a socially committed engineer from Recife. The name "condominial" was given for two reasons. First, a block of houses was treated like a horizontal apartment building—or "condominial" in Portuguese. Second "Condominial" was a popular Brazilian soap opera and associated with the best in urban life. As is evident in the figures below, the result is a radically different layout (with a shorter grid of smaller and shallower "feeder" sewers running through the backyards and with the effects of shallower connections to the mains rippling through the system). These innovations cut construction costs to about 30% of those of a conventional system.

The more fundamental and radical innovation, however, is the active involvement of the population in choosing their level of service, and in operating and maintaining the "feeder" infrastructure. The key elements are that families can choose: (i) to continue with their current sanitation system; (ii) to connect to a conventional waterborne system; or (iii) to connect to a "condominial" system. If a family chooses to connect to a condominial system, it has to pay a connection charge (financed by the water company) of, say X cruzados, and a monthly tariff of Y cruzados. If on the other hand, it wants a conventional connection, it has to pay an initial cost of about 3X and a monthly tariff of 3Y (reflecting the different capital and operating costs). Families are free to continue with their current system (which usually means a holding tank discharging into an open street drain). In most cases, however, those families who initially choose not to connect eventually end up connecting. Either they succumb to heavy pressure from their neighbors. Or they find the build-up of wastewater in and around their houses intolerable once the (connected) neighbors fill in the rest of the open drain.

Individual households are responsible for maintaining the feeder sewers, with the formal agency tending to the trunk mains only. This increases the communities' sense of responsibility for the system. Also, the misuse of any portion of the feeder system (by, say, putting solid waste down the toilet) soon shows up in a blockage in the neighbor's portion of the sewer. This means rapid, direct and informed feedback to the misuser. This virtually eliminates the need to "educate" the users of the system in the do's and don'ts, and results in fewer blockages than in conventional systems. Finally, because of the greatly reduced responsibility of the utility, its operating costs are sharply reduced.

The condominial system has also involved innovation on the wastewater treatment side. In many cases this has meant the construction of small, local, neighborhood treatment facilities. The most appropriate technologies are those which can be modularized relatively easily, with both stabilization ponds and upflow anaerobic sludge-blanket plants working well in Brazil.

The condominial system is now providing service to hundreds of thousands of urban people in Northeast Brazil, and is being extended to other parts of the country. As this happens the system is undergoing constant modification, with an intermediate level of service, with the secondary sewers laid outside the houses along the sidewalk ("sidewalk condominial") as a more expensive (costs about 60% of conventional costs) but popular option in many areas. The danger, however, is that the clever engineering is seen as "the system". Where the community and organizational aspects have been missing, the technology has worked poorly (as in Joinville, Santa Catarina) or not at all (as in the Baixada Fluminense in Rio de Janeiro).



Box 2. Democracy and Water Supply for the Poor: The Case of São Paulo

As with the other cases illustrated in this article, this example shows how the potential implicit in sanitation technologies can only be harnessed once institutions are made to be accountable to the people they nominally serve. In the 1980s, the city of São Paulo, Brazil, made extraordinary progress in providing all of its residents with water supply and sanitation services. In 1980, just 32% of favelas (low-income, informal settlements) had a piped-water supply, and less than 1% had a sewerage system. By 1990, the respective figures were 99% and 15%!

SABESP, the state water utility serving São Paulo, is a sophisticated technical water supply organization. Until the emergence of democracy in Brazil, SABESP had defined its role narrowly and technocratically. Specifically it did not consider provision of services to the favelas to be its responsibility, since it was not able to do this according to its prescribed technical standards, and because the favelas were not "legal". Before the legitimization of political activity in Brazil in the early 1980s, SABESP successfully resisted pressures to provide services to the favelas. While SABESP was resisting this pressure, a small municipal agency (COBES) experimented with new technical and institutional ways of providing water and sanitation services to the poor. On the technical side this did not involve provision of "second-class" service, but of reducing the cost of providing in-house services by using plastic pipe and servicing of narrow roads where access was limited. On the institutional side it meant the community assuming significant responsibility for community relations, and for supervising the work of the contractors.

As the military regime withdrew and was replaced by democratic politics, the pressures on SABESP to serve the favelas increased. Pressures from the communities on SABESP were channelled through the municipal agencies, responsive officials and politicians (including the mayor and governor). Since COBES had shown how it was, in fact, possible to serve the favellas, SABESP had no option but to respond.

The lessons from São Paulo are that democratic politics in Brazil have played a fundamental role in allowing the demands of the poor to be expressed, and in transforming sophisticated technical agencies from being part of the problem into being part of the solution.

world. It is imperative that we learn from these "living laboratories". Whether approaches succeed or fail depends in part on the technology applied but equally on the institutional and financial circumstances.

Technologies

From an ecological perspective, Niemczynowicz identifies two desirable features of new approaches: (a) the importance of containing wastes in relatively short "closed loops", with an emphasis on prevention and on-site treatment; and (b) the advantages of "natural" over chemical treatment. The desirability of a move towards more ecologically-sound closed loop systems is clear, but such schemes often become very difficult to implement in crowded urban areas.

Hundreds of millions of developing-country citizens already contain and treat human wastes within short-closed loops, through the use of pit latrines. Here there are encouraging developments. Over the past 20 years there have been substantial advances in the technology of pit latrines, with ventilated improved pit (VIP) latrines and pour-flush latrines, providing hygienic, aesthetically acceptable facilities. These technologies are being widely promoted and adopted in most developing countries, primarily in rural and low-density peri-urban areas.

The major environmental and health problems from inadequate sanitation arise, however, precisely where population densities become greater. On-site solutions no longer become applicable when densities become too high, with the situation particularly difficult where the ground is rocky or impermeable or where the watertable is high. Under these circumstances, the appropriate scale for the closed loop inevitably expands, since it is now necessary to get the human wastes out of the household. In many instances, the appropriate scale is the neighborhood, with local sewer networks collecting wastewater which is treated by modular treatment systems (including, for example, both stabilization ponds and upflow anaerobic sludge blankets), such as those pioneered in the cities of Brazil (Box 1), and supported by the World Bank and others. In still denser areas, however, the appropriate scale is defined by the city itself, due to economies of scale in terms of both land use and management capacity. And here innovative approaches to waste treatment and water reuse have a major role to play. The interesting example cited by Appasamy and Lundqvist—the use of treated sewage for the growing of high-value tree crops in Madras—illustrates several germane points. First, that management problems—which they describe with the growing of paragrass in Madras—are often major impediments to environmental improvement. And second, that "win-win" technologies, which have both environmental and economic benefits, are likely to play a critical role in improving waste-management practices in developing countries.

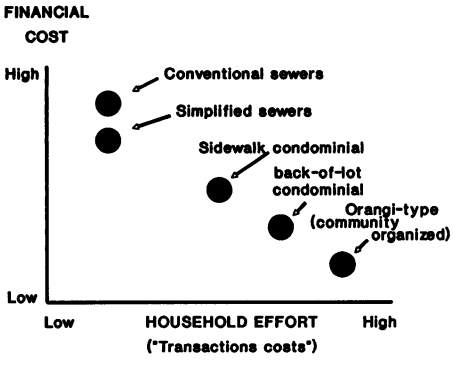


Figure 1. Trade-off between financial and transactions costs for different wastewater collection options.

On the issue of the desirability of natural ecological systems of treatment, care must be taken not to be doctrinaire. After all, conventional sewage-treatment plants usually depend entirely on the natural processes of sedimentation, filtration and biological growth. From this perspective a sewage treatment plant is simply a location in which the functions which are performed naturally in rivers and wetlands are speeded up (by the addition of energy). In this sense, they represent the shorter loops and ecologically-sound alternative to the less-efficient and longer loops available via natural treatment systems.

Institutions

The poor performance of both conventional and new approaches to waste collection and treatment is due primarily to institutional not technological flaws. Conventional schemes fail primarily because of inefficient management; for example, a recent survey found only one of 30 wastewater-treatment plants in Latin America run efficiently. And the vast majority of innovative nonconventional schemes have proven unsustainable because of their administrative complexity and/or need for strong community motivation. Crucially important to the success of these newer, often smaller scale, technologies is the ability to catalyse strong community involvement. Experience suggests that innovation is usually stimulated by committed, technically legitimate outsiders who also possess motivational skills. In all the cases we have

studied, the precise solution emerged gradually as a result of a learning process involving both the community and the "experts". (Box 2). In many instances a significant part of the innovation lies in effectively delineating which are the tasks best done by households, which by community groups, which by private companies, and which by the government. All of these points are well illustrated by the Orangi project in Pakistan (Box 3).

The major trend currently underway in developing countries is to "push down" responsibilities for planning and implementation to communities, households and private firms. This trend emanates not from ideological grounds but from a pragmatic realization that the public sector is quite unable to cope with the huge demand. Harnessing the energy and initiative of the beneficiaries also saves money. Recent research has found a clear tradeoff between the financial costs and the required degree of household involvement (transaction costs) in the operation of the system (Fig. 1).

Finance

Case studies from around the world illustrate that there is tremendous scope for reducing costs—even without fundamental modification in the technological principles. The key element in developing and sustaining low-cost innovations is that the formal institutions are accountable to the population as a whole. Requiring community involvement throughout the process is one way of achieving this. Partnerships with nongovernmental organizations is another. Once again, the Sulabh case, cited by Appasamy and Lundqvist, illustrates the general point, with a private agency providing good quality sanitation and bathing services to the very poor, and with the full costs of the services recovered from the users. Paradoxically, another powerful way of fostering accountability is through charging citizens for the services they receive. The common story to date has been public funding for expensive services, usually beginning in the nonpoor areas of the city and rarely reaching the slums. Middle and upper income residents have been overwhelmingly the major beneficiaries of the public subsidies. This is illustrated for some Latin American countries in Figure 2. For years it has been known that even the poor would be willing to pay significant portions of their incomes to receive clean

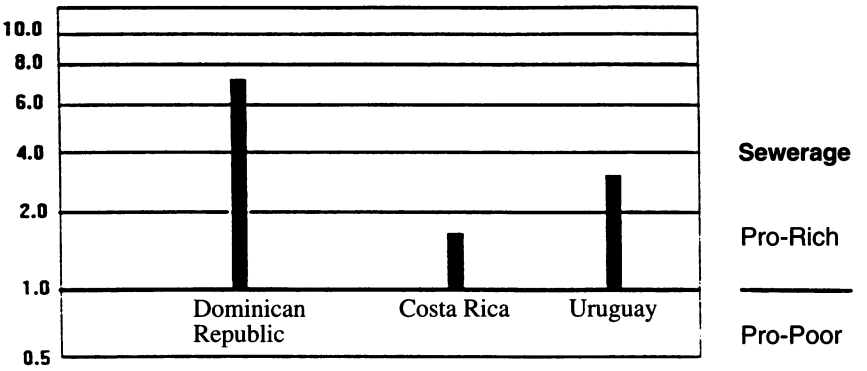


Figure 2. Subsidizing sewerage for Latin America's rich: Ratio of (a) public spending per person in top 20% to (b) public spending per person in bottom 20%.

Box 3. Innovative Sewerage in a Karachi Squatter Settlement: The Orangi Pilot Project

The Orangi Project, like the "condominial" shows how institutional, financial and technical solutions form part of an overall intervention "package" in developing countries.

In the early 1980s, Akhter Hameed Khan, a world-renowned community organizer, began working in the slums of Karachi. He asked what problem he could help resolve. He was told that "the streets were filled with excreta and wastewater, making movement difficult and creating enormous health hazards". What did the people want, and how did they intend to get it, he asked. What they wanted was clear—"people aspired to a traditional sewerage system...it would be difficult to get them to finance anything else." And how they would get it, too, was clear—they would have Dr. Khan persuade the Karachi Development Authority (KDA) to provide it for free as it did (or so they perceived) to the richer areas of the city.

Dr. Khan then spent months going with representatives from the community petitioning the KDA to provide the service. Once it was clear that this would never happen, Dr. Khan was ready to work with the community in finding alternatives. He would later describe this first step as the most important thing he did in Orangi—liberating, as he put it, the people from the demobilizing myths of government promises.

With a small amount of core external funding the Orangi Pilot Project (OPP) was started. The services that people wanted were clear; the task was to reduce the costs so that these were affordable and to develop organizations that could provide and operate the systems. On the technical side, the achievements of the OPP architects and engineers were remarkable and innovative. Coupled with an elimination of corruption, and the provision of labor by community members, the costs (in-house sanitary latrine and house sewer on the plot, and underground sewers in the lanes and streets) are less than USD 100 per household.

The related organizational achievements are equally impressive. The OPP staff has played a catalytic role—they explain the benefits of sanitation and the technical possibilities to residents and conduct research and provide technical assistance. The OPP staff never handles the community's money. The total costs of OPP's operations amounted, even in the project's early years, to less than 15% of the amount invested by the community. The households' responsibilities include financing their share of the costs, participating in construction, and election of a "lane manager" (who typically represents about 15 households). The lane committees, in turn, elect members of neighborhood committees, typically around 600 houses, who manage the secondary sewers. The early successes achieved by the Project created a snowball effect, in part because of increases in the value of property where lanes had installed a sewerage system. As the power of the OPP-related organizations increased, so they were able to bring pressure on the municipality to provide municipal funds for the construction of secondary and primary sewers.

The Orangi Pilot Project has led to the provision of sewerage to over 600 000 poor people in Karachi and to attempts by several municipalities in Pakistan, and several international financing agencies working in the country, to follow the OPP method and, in the words of Arif Hasan "to have government behave like an NGO". The core idea is that the communities themselves fully finance and develop the "internal" or feeder infrastructure, while the public authority is responsible for the "external" (or trunk) infrastructure; including the trunk sewers and wastewater treatment facilities.

Box 4. Structured Learning—the PROSANEAR Project in Brazil

The 1960s and 1970s were the years of the "Brazilian economic miracle", with GDP increasing fivefold in the two decades. This growth was, however, spread very unevenly, with the top 10% of the population accounting for almost 50% of all income. Over the same period the proportion of population living in towns and cities rose from below 50% to almost 75%.

While great progress had been made in providing piped water—the proportion of urban dwellers with an adequate water supply had risen from 50% in 1965 to 80% in 1986—the provision of sanitation services lagged far behind. 50% of all urban dwellers and the vast majority of the poor did not have access to adequate sanitation services in 1986. Accordingly, with the end of military rule in the mid-1980s, one of the major challenges facing a democratic Brazil was, and is, the provision of sanitation services to the poor who live in the urban periphery. In this context, Brazil entered into negotiations with the World Bank for the financing of a project which would provide poor people with adequate sanitation services in urban areas.

As documented in this article, Brazil was a leader in developing innovative institutional and technological solutions to the sanitation problems of the urban poor, and had an able and experienced core of professionals dedicated to this task. These professionals, however, had no illusion about the task ahead—they realized that something had been learned through experiences like the "condominial", but also acknowledged that there had been many failures. They realized that they were a long way from having a generalizable "model" for providing affordable, good quality sanitation services. Accordingly, they persuaded the World Bank to go along with a radically different approach. Rather than a conventional project which would have pre-established service levels, delivery systems and targets, they argued for an experimental program, the objective of which would be to stimulate agencies—including local government and the state water companies—to experiment with innovative institutional and technological approaches to providing sanitation services to the poor. This became the basis for the USD 200 million, World Bank-supported PROSANEAR Project.

The project is now under execution, and shows every sign of being a resounding success. A wide variety of innovative methods are being used at many levels. These range from modes of interaction between the World Bank and the Brazilian bank responsible for executing the project, to methods for involving communities in the decision to participate in the project, to community participation in project execution, down to methods for enabling households to make choices about service levels.

The project is important not only because it will bring improved services to many low-income families, but because it initiates a radically different process of providing services. The key elements are: fostering technical and institutional innovation; monitoring and evaluating processes and outcomes so that adjustments can be made rapidly both within sub-projects and across projects as successes and failures emerge; breaking the master plan/blueprint mold and providing a precedent for similar approaches in other developing countries.

Finally, the project shows that an experimental, innovative approach can be much more effective than conventional approaches to providing services, even in the short run. As a result of the innovations fostered by FROSANEAR, costs in subprojects are dramatically lower than those in conventional projects. Accordingly, far larger numbers of poor people have adequate sanitation services for the first time in their lives.

piped water, but they are often not given the chance. New but strong evidence is now indicating that beneficiaries are generally willing to pay higher fees also for sanitation facilities **if** the quality of service is reasonable. There is also evidence that financial involvement of the community will lead to better design and will force more accountable government.

As noted by Niemczynowicz, the New Delhi Statement (1991) suggested that USD 50 billion per year will need to be spent on investments in water and sanitation in developing countries by the end of the decade. This figure is too high for governments to spend, but probably not too high a figure overall. It represents only about 1% of projected developing country Gross Domestic Product by that time; surely a reasonable amount to invest in this most basic of human and environmental needs. The trick then will be to find a way to allow beneficiaries and NGOs to work alongside governments and aid agencies in jointly financing and implementing the most efficient, cost effective and administratively feasible schemes.

A Program of Structured Learning

New ideas in the field of water, sanitation and waste management abound. Very rarely is the weaning out of the good from the not-so-good ideas possible in Washington, Stockholm, Delhi or Nairobi—it is only through the litmus test of performance in the field that such weaning is possible. And even for the good ideas, success is seldom instantaneous. As the condominial and Orangi cases graphically illustrate, it requires years of careful, patient, systematic learning to ensure that good ideas are translated into practical improvements in the lives of people.

The urgent task now facing the water and sanitation sector in developing countries is to build on the "structured learning" philosophy underpinning the condominial and Orangi models. Box 4 indicates how this is being done in the PROSANEAR Project of the Government of Brazil, with support from the World Bank.

In our view this "structured learning" approach provides a fundamental principle around which to mobilize the energies and resources of individual families, developing countries, and external support agencies. We suggest that greater attention be given to the "structured learning" concept, its substantive implications, and its implications for those involved in the critical task of improving the environment in which people in developing countries live.

References and Notes

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