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SUSTAINABLE DEVELOPMENT OF WATER RESOURCES, WATER SUPPLY AND ENVIRONMENTAL SANITATION

Sanitation Success Stories in India and Implications for Urban Sanitation Planning

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Meeting the challenges of sanitation in citywide planning requires critical reflection of case studies, and the transfer of lessons learned. Drawing from projects of the Bremen Overseas Research and Development Agency (BORDA) in India, we will describe how projects were developed from a planning perspective in two case studies: a community and a private organisation. Using these and other experiences of BORDA, we describe the issues and lessons learned in the area of sanitation planning. BORDA's experience of including decentralised sanitation options in city planning is indicative of the wider development sector; where the work of collaborations such as the Cities Alliance (CA) have a primary focus of planning level interventions. The criteria suggested in this paper therefore have implications for the expanding role of decentralised planning across the development sector.

Introduction

INADEQUATE funding, constrained resources and lack of attention to the contextual factors of particular locations have been linked to the critical state of urban sanitation in developing regions (Evans 2005; Gutierrez et al. 2003; Abey Suriya et al 2005). Decentralised sanitation options may have greater potential to avoid these factors than centralised options, as they are generally less resource intensive, more adaptable to local conditions and regarded as better able to meet broad sustainability criteria (Lens, Zeeman & Lettinga 2001; Newman 2001). The experiences of the Bremen Overseas Research and Development Agency (BORDA) confirm these observations.

BORDA, a German based Non Government Organisation (NGO) with projects in India, Indonesia, Vietnam, China and Lesotho, has significant depth of experience implementing solutions to the challenges of sanitation in conjunction with local partners. This paper focuses on the sanitation projects of BORDA-India, which manages over 150 projects in eight of India's 35 states and union territories. BORDA projects facilitate basic needs service provision to urban and peri-urban communities in developing countries. BORDA's services are considered 'decentralised', because all inputs and outputs of the process are managed within the boundaries of the project site, and rely upon community or customer-based decision-making processes.

BORDA increasingly uses citywide planning to disseminate decentralised sanitation services. Progress toward sustainable and appropriate integration of decentralised sanitation options has occurred by working closely with the cities' infrastructure planning authorities.

Across the development sector, organisations are increasingly pitching sanitation interventions at the planning level. One example is the Cities Alliance (CA), an international collaboration of organisations aimed at scaling up development initiatives. Recognising that development initiatives often achieve greater impact when incorporated into the overall master plans for a rapidly developing city, the CA administers City Development Strategies to plan and prepare for future growth, in tandem with local authorities. A core element of the strategies is water and sanitation, requiring planners to consider the full range of sanitation options available to cities, including, decentralised options.

We demonstrate how planning level negotiations led to decentralised sanitation in two case studies. Using these and other experiences of BORDA, we describe the issues and lessons learned in the area of sanitation planning.

Case Studies

In Indian cities and towns, currently only 28% of households are connected to a sewerage system (WHO/UNICEF, 2004). Traditionally, planners understood the solution to sanitation problems to be centralised infrastructure, comprising flush toilets, sewerage and sewerage treatment. Owing to the failure of the infrastructure to cater to the demands of rapidly urbanising cities, decentralised sanitation increased in popularity, commonly implemented by local NGOs. This approach, while locally sustainable, had limited influence because of economic and regulatory constraints on the NGOs.

Mahajan Nagar, Nagpur City

The case study of Nagpur City shows the potential to overcome this limitation, through the implementation of local, decentralised sanitation in tandem with the city authorities and embedded in city development plans.

Mahajan Nagar is a peri-urban slum in the city of Nagpur; with a population of 850 relocated slum dwellers in 167 households on the banks of an unlined drain (Nallah) carrying sewage from Nagpur city. A trunk sewer carrying wastewater from 1000 houses upstream passes through Mahajan Nagar and discharges into the drain.

The specific objectives of the project were to provide sanitary and drainage infrastructure to the 167 houses of Mahajan Nagar to prevent contamination of drinking water from hand-pump based bore wells.

Planning considerations

Consultation with the community and local authorities revealed that no provision had been made in the city plans for wastewater treatment for this community even though it is a requirement of central law. With limited funds, decentralised sanitation was preferred to centralised options. Other factors making the location suitable for decentralised services were:

- No existing sanitation services
- Topography favoured gravity operation
- Community has land titles and was therefore ready to invest
- Land was available for irrigation reuse and nutrient sinks
- The local NGO had good rapport with the community
- The government was willing to provide land
- Community was willing to invest in sanitation.

The decentralised sanitation system installed included initial treatment with a 575m³/day aerobic settler and further treatment for 35m³/day with anaerobic filter and a planted gravel filter. A simplified sewer system connects the 167 houses to the trunk sewer. For houses that agreed to individual toilets (120 households), these were installed. Photograph 1 shows the sanitation infrastructure during construction and the proximity of the infrastructure to the community.

A community-based organisation was formed and people trained to operate and maintain the infrastructure. Local authority employees were trained in the routine maintenance of the system (such as desludging of the settler every two years). The community was engaged in health and hygiene education and awareness focusing on personal, household and community hygiene.

Project Outcomes

Mahajan Nagar was transformed from a typical slum to a low-income quarter as a result of the project. The community obtained 90% sanitation coverage, a reduction of open defecation by 80% and a reduction in medical expenditure by 30%, primarily through the reduction of children's gastro-enteritis cases. The project was followed by the upgrading of other services in the area such as pavements and roads.

Total project expenditure for the sanitation intervention at Mahajan Nagar was 3,015,000 IR (57,000 EUR). The distribution of financing among the parties was 30% from the local government, 20% from the community and 50% from the donor agency. Table 1 shows the breakdown of these costs, and how they compare with equivalent centralised figures. All costs are significantly lower in the decentralised option, particularly operational costs.

Discharged wastewater now meets the state's environmental standards (<30 mg/L Biochemical Oxygen Demand) and the total nutrient load (in Nitrogen) was reduced by 15% by reusing some wastewater for irrigation.

The skills and organisational capacity of the community was enhanced as a result of the project. The community took up the construction and protection of the site during construction and operation. Other social benefits were an observed increase in acceptance of the ex-slum dwellers by the surrounding community.

Gokaldas Images, Bangalore City

The second case study is an example of the private sector working in tandem with local authorities to implement decentralised wastewater services.

Gokaldas Images Ltd. is a modern textile factory specialising in garments, fashion apparel and designs, in the industrial area of Bangalore. It employs a workforce of around 400. In



Photograph 1. Sanitation infrastructure (foreground: baffle reactor and pond) at Mahajan Nagar community (background)

**Table 1. Costs comparison at Nagpur:
Centralised versus Decentralised
(Costs in Indian Rupees (IR))**

	Decentralised	Centralised ²
Sewerage [per household]	14,500	25,000
Treatment Infrastructure [per m ³ wastewater treated]	3.7	35 - 60
Operational cost [per m ³ wastewater treated]	Negligible ¹	5 - 30
¹ Approximately 15,000 IR /yr, this figure is negligible when converted into IR/m ³ .		
² Centralised costs from the Indian Central Pollution Control Board.		

**Table 2. Costs comparison at Gokaldas:
Centralised versus Decentralised
(Costs in Indian Rupees (IR))**

	Decentralised	Centralised ²
Investment cost	735,650	710,000
Operational Cost (pa)	11,650	76,000
² Centralised costs from the Indian Central Pollution Control Board.		

order for the effluent discharge from the factory to comply with Karnataka State Pollution Control Board (KSPCB) standards, a form of treatment was required.

The goal of the project was to provide an economically competitive, reliable, onsite, wastewater treatment solution that could also provide the water required to landscape of the factory's outdoor garden area.

Planning considerations

Factors that made this location suitable for decentralised services:

- No existing sanitation services
- Land was available for irrigation reuse and nutrient sinks
- Legal obligations for treatment – industries with more than 250 employees must have onsite treatment
- High water price (supplied by tanker)
- Integration of existing centralised infrastructure possible.

The decentralised treatment system installed provided for a daily flow of 14m³, and comprised a settler, an anaerobic baffled reactor, an aerobic planted gravel filter and a polishing pond. The treated effluent irrigates the outdoor areas of the factory. The factory's maintenance staff received training on the operation and maintenance requirements of the system.

Project outcomes

Table 2 shows that although the initial investment cost is slightly higher than the centralised system, operational costs make the decentralised option significantly cheaper after one year.

The treated effluent met the state Pollution Control Board standards for irrigation, and all the nutrients were therefore able to be recycled onto the site.

Implications for sanitation planning

Citywide planning for sanitation involves two key elements: mapping the areas of a city where sanitation interventions may be required, and assessing the different options available for each site. In the mapping exercise, three sanitation scenarios exist:

- areas with no sanitation infrastructure
- areas which are not served currently but where centralised services are planned,
- areas currently served by centralised services.

For areas where sanitation services are not provided or planned, the potential for a sustainable and appropriate integration of decentralised services should be assessed. Where centralised services are planned, decentralised options might provide a viable interim solution. In India, this can be particularly useful when centralised services are planned for the long-term, but no service exists. In BORDA's experience, if the service gap was longer than three years, decentralised services were found to be a viable interim solution. When current centralised services experience problems such as insufficient treatment capacity, decentralised services may replace them.

In the two case studies described here, planning level decisions were based on an assessment of the potential of decentralised options to progress sustainability in comparison to centralised options. Ideally, a formalised assessment of the relative sustainability of all sanitation options would occur. In lieu of such a framework, planners and decision makers might consider the following factors as part of an investigation of different sanitation approaches.

1. Potential to increase socio-economic sustainability and restore dignity to the community.

The following socio-economic impacts were attributed to the decentralised projects in the case studies:

- Decreased illness leading to increased work capacity and reduced health bills
- Increase in skills and community organisation
- Increased income owing to local employment generated by the need to operate infrastructure
- Sanitation services may hasten the provision of other services to the area by local authorities.

2. Potential to increase environmental sustainability.

The potential to reverse environmental degradation may be assessed by:

- Ability to close nutrient loops using irrigation. For this to be successful, effluent quantity must be sufficient (approximately 2–4 L/m²) and nutrient sinks such as parks and green areas be available
- Increased responsibility of private organisations for the outputs of industrial processes
- Reduced greenhouse gases and resource use by using gravity and minimal infrastructure.

3. Potential for increased technical sustainability.

Decentralised options may be more technically sustainable than centralised options in certain areas because of:

- Reduced operational skills or costs required as there are minimal mechanised components
- Increased performance relative to centralised systems in some topography such as hilly areas
- Modular infrastructure easier to adjust to meet changing conditions or incorporate design improvements.

Conclusions

Decentralised sanitation services are critical to the sustainability of rapidly urbanising cities. The recognised shortcomings of centralised infrastructure has led to an increase in decentralised services in some areas, but the potential of these services is yet to be reflected in the planning of cities.

One exception is BORDA's experience in India. Through partnerships with government, a process of including decentralised services in the planning of Nagpur city has begun, with a master plan for this city due late in 2006. Using these and other experiences of BORDA, we described the issues and lessons learned in the area of sanitation planning.

In the future, these considerations may be incorporated into a general framework for use across the development industry, to assess the potential of alternative sanitation options in rapidly urbanising cities.

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