

# Methodology to compare costs of sanitation options for low-income peri-urban areas in Lusaka, Zambia

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## Abstract

Urban slums and low-income peri-urban areas in developing countries are characterised by a lack of infrastructure. The absence of sustainable sanitation systems is one of the causes that can lead to a high level of water-borne diseases in these areas, especially during the rainy season. This paper presents a methodology for cost comparisons of sanitation system options with a focus on excreta management (a sanitation *system* consists of the household toilets, collection and transport of excreta, treatment and storage, and transport of sanitised excreta to reuse sites). Greywater collection and treatment are excluded from the analysis for simplicity reasons.

We used three low-income peri-urban areas in Lusaka, Zambia, to demonstrate our proposed methodology. The population density in the three peri-urban areas ranges from 104 to 244 people/ha. Unlined pit latrines are the most common form of excreta management, even though drilled boreholes and shallow wells are used as sources for drinking water in the same areas.

Based on four selection criteria (no use of water for transporting the waste, low costs, waste sanitisation, and no contribution to groundwater pollution from stored excreta), we have short-listed two options which meet most or all of the criteria: A conventional low-cost option (Option 5: VIP latrines with downstream processing) and an ecological sanitation option (Option 6: urine-diversion dehydrating (UDD) toilets with downstream processing). The concept designs for both options are based on the entire peri-urban population in Lusaka of approximately 1.23 m. people, and on the assumption that 12 residents who live on the same plot (or 'compound') would share one toilet.

The paper details the assumptions used to create a set of default model input parameters which are used in the cost equations to calculate capital costs, annual operating costs and net present values (NVP). Based on this basic financial analysis, we calculated the following indicative costs: capital costs of 31 €/cap and 39 €/cap for Option 5 and Option 6, respectively. Annual operating costs *per capita* were estimated to be 2.3 €/a-cap and 2.1 €/a-cap for Option 5 and Option 6, respectively.

The NPV for Option 6 is about 14% higher than for Option 5 but the difference is not significant, given the accuracy of the cost estimate (about  $\pm 25\%$ ). Overall, this paper shows that the two options are difficult to differentiate based on cost alone. The financial model allows examination of the relative contributions of the different components to the overall cost of the sanitation system. For example, the costs of urine storage and transport are significant contributors to the capital and operating costs of the Ecosan option, and ways to reduce these costs should be investigated.

**Keywords:** NPV, millennium development goals, groundwater, ecological sanitation, Ecosan, VIP latrine, UDD toilet, financial model, reuse, excreta