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INTEGRATED DEVELOPMENT FOR WATER SUPPLY AND SANITATION

Improved water supply in majengos

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INFORMAL SETTLEMENTS HAVE become a consistent feature of the urban landscape in Kenya. They are proliferating in all the larger urban centres, and constitute the primary source of new urban housing. Approximately 55 per cent of the population in Nairobi, the capital and primate city, and 40 per cent of people in other urban centres live in informal settlements (Majale, 1998). The informal settlements, which are a reaction to fundamental defects in housing mechanisms, have formed and evolved in a wide range of ways. But given the fact that the settlements have been mostly built at low monetary cost and with very limited resources, certain deficiencies originating from the nature of their development are identifiable. Foremost among these are the environmental disamenities associated with the prevalent poverty in informal settlements.

A number of typologies of informal settlements are distinguishable in Kenya. One of these is *majengos*, which can be found in all the major urban centres. A typical characteristic of m*ajengos*, which is also common to all informal settlements throughout the country, is that environmental infrastructure–water, sanitation, drainage and solid waste disposal–and other basic urban services and amenities are elementary, deficient or non-existent.

The present paper draws on data from research work for the author's doctoral thesis and compares the water supply situation in two *majengos* in two secondary towns in Kenya: Swahili Village in Machakos and Bondeni in Nakuru. The latter settlement was upgraded under the World Bank-funded Third Urban Project. A primary objective of the upgrading project was to improve residents' access to an adequate and convenient supply of potable water. The upgrading exercise included the following physical elements: provision of a sanitary unit (comprising a tap, cistern-flush toilet and shower) on each plot; construction of profiled and compacted earth roads and unlined storm water drains; provision of communal solid waste collection facilities; and erection of street lights.

In this paper, households access (both owners and tenants) to water-supply systems in the two *majengos* is examined; consumption patterns analysed; satisfaction with water supply appraised; priority ranking of water among on-plot services evaluated; and willingness-to-pay for improved water supply assessed. Household methods of wastewater disposal are also reviewed. Recommendations for integrated improvement of water supply in *majengos* are thereafter made.

Household access to water supply

People are considered adequately served with water if they have "*access* to an *adequate amount of safe* drinking water located within *a convenient distance* from the user's dwelling (WHO/UNICEF, 1993:13, cited in Satterthwaite, 1995:v-vi). But there is also a multiplicity of statistics and contentions in the literature regarding the quantity of water required to meet basic needs. One of these, UNCHS (1989:7), asserts that: "Basic needs in domestic water supply can be met by the regular and reliable provision of between 30 and 50 litres per capita per day (lcd) of water of adequate quality for drinking, food preparation and personal and domestic hygiene. Such a level of water is considered adequate for the control of water washed diseases." This is the criterion that shall be adopted for purposes of this discussion.

The per capita quantity of water consumed daily depends on climate, and also varies with physical, social and cultural conditions, leading to considerable disparities between localities. However, the quantity of water to which people have access is possibly the most significant determining factor of the per capita quantity of water consumed daily. The level of service has also been found to signally influence water consumption. The cost of water and the time taken to collect it further determine the quantity used, as do religious practices. Since water is not light, the distance it has to be carried will also have a bearing on consumption levels (UNCHS, 1986; Cotton and Franceys, 1991; Hardoy *et al*, 1992).

Communal water points

Communal water points, of one form or another, are the water supply source for multitudinous low-income urban households in Kenya. Several problems associated with communal water points have, however, been noted (Majale, 1998). These include access; wastage; congestion; drainage; damage (resulting in leakages from taps and high maintenance costs); and vandalism. In many cases water is available only intermittently. Where communal water points are used, water consumption is largely conditioned by the time and energy required to collect and carry the water to the home. Where households do not pay in cash for water obtained from communal water taps, they commonly pay in time queuing or in travel time to and from the source.

Communal water points serve 21 per cent of all households in the two *majengos*. In Swahili Village, which has not benefited from any upgrading interventions, 32 per cent of households obtain their water from communal

Table 1. Household access to water supply (percentage frequencies rounded)

	All	*Swahili village*	*Bondeni*
Communal water point	21	32	16
On-plot connection	60	30	75
Itinerant water vendor	6	8	6
Water kiosk	10	30	2
Communal water point / On-plot connection	1	-	2
Another residential estate	1	-	-

water points compared with 15 per cent in Bondeni which has been upgraded (Table 1).

Households that obtain water from communal water points in the two settlements consume 18.4 litres per capita daily (lcd) at the mean (median=12.5). The mean consumption of households that use this source in Swahili Village is 18.8 lcd (median=11.4), while that of their opposite number in Bondeni is comparable at 18.0 lcd (median=14.6) (see Table 2). These levels of consumption are well below the amount required to meet basic needs in domestic water supply.

The majority of households in the two settlements (76 per cent) who obtain water from a communal water source are dissatisfied with the service. The number of residents dissatisfied with the service is higher in Bondeni (88 per cent) than in Swahili Village (65 per cent). Tenants in the two settlements are more dissatisfied than owners.

On-plot water supply

However preferable on-plot water supply may be in principle, this service is wanting in the vast majority of informal settlements in Kenya. Because water resources and distribution systems in urban centres in Kenya are inadequate to meet the required demand, although intermittent water supplies are objectionable from the point of view of contamination danger, supply to most informal settlements in Kenya operates under such conditions. Thus, where on-plot connections exist, water supplies are almost always intermittent. Still, the proportion of dwelling units with an on-plot water supply is a more reliable indicator of adequate and convenient water supply than water available at a 'convenient distance' (UNCHS, 1996:266:).

In the two *majengos*, 60 per cent of households have access to an on-plot water supply. But a far greater number of households in Bondeni (75 per cent) have access to this level of service as a result of the upgrading project than do households in Swahili Village (30 per cent) (Table 1).

The mean water consumption of all households in the two majengos with access to an on-plot water supply is 23.8 lcd (median=12.5). In Swahili Village, the mean quantity of water consumed by households that use this service is 27.8 lcd (median=13.3) compared with 23.4 lcd (median=17.1) for households with access to a like source in Bondeni (Table 2). The mean consumption of tenant households with access to an on-plot water supply (38 lcd) in Swahili Village is more than three times that of owner households (8 lcd). Mean consumption levels of the two tenure groups in Bondeni are, on the other hand, proportionate (owners=23 lcd; tenants=24 lcd). But these levels of consumption are all below the 30-50 lcd deemed adequate to meet basic needs in domestic water supply.

The majority of households (80 per cent) in the two *majengos* with access to an on-plot water supply are, as one might expect, satisfied with the service. In Swahili Village, 88 per cent of those with access to this service are satisfied, as are 78 per cent in Bondeni. More owners than tenants in the two settlements affirmed satisfaction with the service.

Water vendors

In many urban centres in Kenya, where no water supply is provided by public authorities–as is common in informal settlements–poor households are dependent upon high-cost private vendor services, whose quality is not guaranteed, in water provision. While the unit prices of water are

Table 2. Household water consumption (mean [and median in brackets] litres per capita per day)

	All	*Swahili village*	*Bondeni*
Communal water point	18 [13]	19 [11]	18 [15]
On-plot connection	24 [17]	28 [13]	23 [17]
Itinerant water vendor	27 [20]	19 [14]	32 [30]
Water kiosk	23 [16]	22 [16]	- -
Communal water point / On-plot connection	35 [35]	- -	35 [35]
Another residential estate	11 [11]	- -	11 [11]

Table 3. Means of household waste water (sullage) disposal (percentage frequencies rounded)

	All	*Swahili village*	*Bondeni*
Pour just outside house	26	22	28
Pour elsewhere within plot	9	20	3
Pour into soakage pit	4	9	1
Pour into open drains	52	26	66
Pour down sewer	10	22	3

many times more than the amount paid by better-off households for publicly provided piped water, it has been argued (Cotton and Franceys, 1991) that commercial vendors are satisfying a vital need for which people are prepared to pay a high price.

Only a small minority (6 per cent of all households) in the two *majengos* purchases water from itinerant water vendors (Table 1). What is notable, however, are the relatively high consumption levels of users of this service. Households that employ the services of itinerant vendors consume, on average, 27 lcd (median=200. In Swahili Village users of this source consume an average of 19 lcd (median=140) while their counterparts in Bondeni use 32 lcd (median=30). The latter's mean consumption is sufficient to meet basic needs. However, the majority of households (80 per cent) supplied with water by commercial vendors in the two *majengos* are, not surprisingly, dissatisfied with the service.

Water kiosks

Water kiosks can be found in numerous low-income urban informal settlements in Kenya. Indeed, in Nairobi, where the greater number, by far, of informal settlements are located, 86 per cent of all households obtain water from water kiosks (MDC, 1994). There are, however, no water kiosks in Bondeni, and only one is in operation in Swahili Village. This kiosk supplies 30 per cent of households in the neighbourhood (32 and 29 per cent of owner and tenant households respectively) (Table 1).

The mean amount of water consumed by households that obtain their water from the water kiosk is 22.6 lcd (median=15.8). The mean per capita quantity of water consumed daily by tenant households (32 lcd; median=23) is enough to meet basic needs; but owners consume less than half this amount. Of the households that use this source, 56 per cent are satisfied with the service. Far more owners (75 per cent) are satisfied with the service than tenants (38 per cent).

Other sources

A very small minority in Bondeni gets their domestic water supply from a neighbouring residential estate. Because of the distances involved, and the time and energy needed to collect and carry water back to the home, the per capita quantity of water consumed daily by this group is, not surprisingly, particularly low–a mere 11 lcd. And, yes indeed, they are wholly dissatisfied (100 per cent of users) with this water supply source.

Household disposal of waste water

The removal and safe disposal of household waste water is a critical environmental health need. The volume of waste water produced is determined by domestic water usage, which is in turn dependent upon the quantity of water to which households have access. The health implications of sullage disposal depend largely on the system utilized. But disposal of waste water into open drains provides the most readily identifiable health risk–mosquito breeding (Feachem *et al.*, 1981; Cotton and Franceys, 1991).

There are various ways of disposing of domestic waste water in informal settlements. Within plots, waste water can be disposed of by allowing it to percolate through soil by means of soakage pits or, where appropriate, using it for garden watering. Waste water can also be discharged in stormwater drains or, where they exist, into sewerage systems (Cotton and Franceys, 1991). Very often, household waste water is freely discharged onto the ground surface, without concern for its ultimate fate, and channels containing sullage, latrine discharges and solid waste which pose a serious environmental problem are formed (UNCHS, 1986).

Approximately one-half of all households in the two *majengos* dispose of their waste water by throwing it into open stormwater drains (Table 3). One of the components of the upgradation exercise in Bondeni was, in point of fact, the construction of unlined open drains. Most households (66 per cent) in Bondeni now dispose of their domestic waste water by throwing it into these drains. Apart from creating breeding grounds for mosquitoes, sullage disposed of in this manner is the source of odious smell when coupled with domestic solid waste thrown into the same drains.

Only 10 per cent of households in the two settlements discharge their water into the sewerage system–a scant 3 per cent do so in Bondeni, the upgraded settlement. Domestic waste water is thrown just outside the house by 28 per cent of households in Bondeni, while 16 per cent use soak pits within the plot (Table 3).

Household rating of on-plot services

Householders, be they high income or low-income, in affluent neighbourhoods or in informal settlements, are unlikely to be in total accord about which domestic services and facilities they deem essential and which ones they consider unnecessary. But going by experience, it is almost certain that the vast majority will rate an adequate supply of water a first priority basic need (Majale, 1998).

When asked to indicate how necessary they considered an on-plot water supply to be (i.e., essential, desirable, indifferent, not necessary), 93 per cent of all householders in the two *majengos* (90 per cent in Swahili Village and 94 per cent in Bondeni) stated that it was essential. On-plot disposal of waste water was deemed essential by 71 per cent of all households (77 per cent in Swahili Village and 68 per cent in Bondeni).

When asked which three domestic services, in order of priority, they rated as being most important in an upgrading exercise, 73 per cent of householders in the two *majengos* rated on-plot water supply first. In Swahili Village, 68 per cent of householders (69 and 67 per cent of owners and tenants respectively) rated on-plot water supply first compared with 76 per cent in Bondeni (75 per cent of owners and 77 per cent of tenants).

Willingness to pay

It does not necessarily follow that because someone can afford a service they will be willing to pay for it. It is therefore necessary to consider 'willingness to pay' when assessing prospects for cost recovery in upgrading projects. 'Willingness to pay' depends not only upon income levels, but also upon perceptions of the necessity and advantages of the proposed project; the perceived benefits to be gained from the service, the characteristics of any existing service, and the level of service being purchased. Willingness to pay for a particular service depends also on the priority given to that service. (Cotton and Franceys, 1992; Tayler and Cotton, 1993).

Of the households in the two *majengos* that rated on-plot water supply their number one priority service in an upgrading project, 94 per cent affirmed they would be willing to pay towards provision of the same. Fully 97 per cent of tenant households in the two settlements expressed willingness to pay compared with 91 per cent of owners. In Bondeni, 95 per cent of householders (91 and 98 per cent of owners and renters respectively) who rated water first affirmed willingness to pay as did 92 per cent (89 per cent of owners and 94 per cent of renters) in Swahili Village.

Conclusions and recommendations

From the foregoing discussion, it is evident that the majority of households in the two *majengos* do not have access to an adequate supply of water to meet basic needs, even though they rate it as a first priority essential service. However, the greater number of householders, both owners and tenants, are willing to pay for an improved water supply. And improvements in the availability and quality of water are possible at relatively low cost and with good possibilities for cost recovery.

Optimization of existing water systems, and better management, maintenance and repair of existing water systems is advocated as this can improve services more inexpensively than increasing capacity–it can lead to an increased availability of water and substantial savings. Effective operation and timely maintenance of facilities will ensure optional use of limited resources and lead to reduced demands for replacements.

Another cardinal area for consideration is the use of lower cost more appropriate technologies. What are required are technologies that require minimum municipal commitment and in which potential users create and maintain services through "self-help". Research and development in this direction is encouraged

The provision of a water supply to informal settlements, if not accompanied by waste water systems will inevitably lead to the degradation of the quality of the residential environment along with the spread of communicable diseases. Thus, where an on-plot water supply is provided, there must also be provision for sullage drainage into either a sewerage system or an on-plot soak pit. Health education campaigns which create a greater awareness of safe methods of sullage disposal and the potential of new technologies for improved living conditions should be promoted

Incremental upgrading, which gives residents the opportunity to upgrade environmental infrastructure as and when they can afford it, is recommended. Existing standards for infrastructure should also to be reviewed, as modifications to official standards can often produce significant cost savings with little or no reduction in performance. . Projects that demonstrate lower-cost approaches and appropriate standards for the provision of infrastructure to informal settlements should be implemented.

Finally, the regularization of informal settlements, including water supply infrastructure, should be expedited as this can create conditions for residents to pay water charges regularly and thus contribute to the sustainability of urban water supply systems.

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