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R FOSTER and T R CROSSLEY**THE ENGINEER IN AN UNDERPRIVILEGED ENVIRONMENT**INTRODUCTION

As is already very well known Urban growth accelerated by migration from rural areas has, in many countries led to the proliferation of low income settlements, often including unofficial or even illegal squatter communities.

The circumstances pertaining to such communities can vary enormously and they are known by a variety of names but they invariably involve severe overcrowding, a lack of adequate municipal services and are fraught with health hazards.

Various attempts have from time to time been made by the respective responsible authorities, usually with only very limited success, to deal with the resultant problems.

The Government of Ghana, in collaboration with the World Bank sought to develop a new approach to the housing of low income groups in major urban areas and in this connection initiated studies in early 1977 by a multi-disciplinary group of Consultants working with a team of Ghanaian specialists, and from these studies there evolved the Ghana Urban Development Project.

The project was concerned with the upgrading of low income housing areas in five cities, namely Accra, Tema, Kumasi, Tamale and Sekondi-Takoradi, and with the provision of sites and services in four of them.

The Studies undertaken were very wide ranging and included an investigation of existing engineering infrastructures, especially water supply, drainage and sanitation, and of the options available for the future.

Because of the very nature of the problems being tackled, namely those associated with low-income sections of the community, the pursuit of low cost solutions was imperative. In fact to be of benefit to anything more than a very small minority of those in need any scheme devised had, after an initial investment of funds, to be virtually self perpetuating, depending for continuing finance very largely upon slightly increased rents, rates or taxes etc. from those who quite clearly could afford but little.

SITES STUDIED

It is not proposed as part of this paper to explain exactly how the particular sites were chosen, suffice it to say that the severity of existing problems and the need for action were largely instrumental in their selection.

"Sites and services" projects were proposed in the following locations:-

- Accra - at a site north of Teshie
- Tema - at a site in Community 12 and extensive infilling within Ashaiman
- Kumasi - at a site north of Kumasi integrated within the area known as Moshie Zongo.
- Tamale - Kaladan Barracks site.

Upgrading programmes were proposed at the following:-

- Accra - Nima
- Tema - Ashaiman
- Sekondi/Takoradi - Kwesimintim
- Kumasi - Moshie Zongo (existing area)
- Tamale - parts of Wards E and F.

Table 1 gives particulars of areas, ultimate proposed population and density for the sites and services projects whilst Table 2 gives similar information in respect of upgrading sites.

Table 1 - POPULATION AND AREA SITES & SERVICES

Site	Area (Acres)	Popul- ation	Density (pers/acre)	
			Gross	Net
Teshie	122	10,080	83	139
Tema	32	2,010	63	138
Moshie Zongo	86	6,990	81	138
Kaladan	50	3,930	79	142
	290	23,010	79	139

Table 2 - POPULATION AND AREA - UPGRADING

Site	Area (Acres)	Popul- ation	Gross density (Pers/Acre)
Nima	473	80,000	169
Ashaiman	420	77,100	184
Kwesimintim	120	12,100	100
Moshie Zongo	104	8,650	83
Tamale E & F	95	14,700	155
	1,212	192,450	159

Very early in the studies it became apparent that the problems of one city differed in many ways from those of another. The reasons for such variations are not difficult to understand, arising largely from differences in topography, in cultural backgrounds, in proximity to existing major infrastructure facilities and so on.

Competing financial demands

In the case of both upgrading and of sites and services the financial demands far exceed those of the services considered in this paper and the overall studies extended over a wide range including educational needs, shopping facilities, transport requirements, employment, health clinics and religious considerations etc.

Administering Organisation

The need for an organisation of some suitable type, existing or newly created, to administer any proposed scheme was studied in depth. Amongst the various duties of such an organisation would be the responsibility of ensuring that facilities once provided are satisfactorily maintained.

Maintenance

In the course of our studies we found numerous examples of facilities which had been well intentioned, often well designed and which had failed or fallen into disuse through lack of adequate maintenance or non-availability of spare parts.

In some cases the lack of maintenance was not merely the result of a lack of will to maintain but the result of sheer impossibility. By way of illustration of this point we would quote a well designed communal toilet block with water flush sanitation, septic tank and soakaway, provided by a well meaning authority at Ashaiman (near Tema) which has now been built around so densely that it is no longer possible for the municipal emptying vehicle to gain access.

By way of contrast a much simpler aqua privy block within the same locality to which

adequate access is still available has been maintained in a manner which is a credit to the local authority. As a consequence the well maintained unit is also well used.

Yet another lesson is to be learned from a second water flush type toilet block in the same area found to be out of service as a result of theft of some of the sanitary fittings. The authority however well intentioned cannot keep on replacing parts which are regularly stolen.

In this case the simpler type of installation without complex equipment had clearly provided a more satisfactory solution.

Scale of Provision of Facilities

Under-provision of a facility, strangely enough, can often in itself be a cause of maintenance difficulties in that the resultant over-use demands extremely frequent attention which cannot always be provided. This problem is experienced by the Accra City Council in the maintenance of the aqua privy and night soil toilet blocks already existing at Nima. Once over-use has led to a particularly unsanitary condition people tend to stop using the facility and foul the approaches instead which in turn makes maintenance a particularly unpleasant task.

It is thus not necessarily the case that a little provision is better than non at all. If the provision of a toilet block serves only to concentrate pollution at one spot, then one might well be better without it altogether!

Talking to the People

Of all the features encountered in our studies the one which stands out above all others is the fact that in every case, in every city and on every site we are providing for the needs of people, and we feel that the importance of meeting and talking to the people involved cannot be over emphasised.

By the people involved we mean both the residents of existing under-privileged communities (the "Client Population") and those who will have dealings with them in and after the implementation of any proposals emerging from the studies.

It is self evident, but we believe worthy of repetition, that any proposals of the study team will, to have any chance of success, be very much dependent upon the co-operation of the client population. In order to convince someone already very poor that parting with more money, however little, is in his best interests requires that his confidence be gained and that those "best interests" be very well defined and understood.

In our studies contact was made at various levels, with Government Departments, State Corporations, City Councils, Regional Commissioners, Town Development Committees, Welfare Committees, Tribal leaders, acknowledged local

representatives, spokesmen and with many individuals.

Needless to say many different points of view were expressed and all were not easily reconcilable.

These contacts provide the opportunity for genuine two way communication and the study team must be just as ready to listen, learn and consider as to talk and endeavour to convince.

Direct discussion with individuals produced one or two surprises as for instance when the occupant of a simple dwelling at Ashaiman placed a supply of electricity much higher in his priorities than a piped supply of water. Once explained, his reasons were understood. His dwelling lacked ventilation on account of the density and orientation of neighbouring buildings, and to possess an electric fan was his greatest ambition. As he put it to us he could carry some water to his home but he could not carry in his ventilation!

Features of Specific Sites

We now propose to mention some of the respects in which various sites were found to differ from one to another.

TAMALE

Unlike most of the other sites the low income areas of Tamale are not so much suburban communities which have sprung up since the second world war but are in the main part of the long established central area. Their problems are much more those of the town on a whole than is the case with the other cities.

The one feature which dominated the whole scene at Tamale at the time of the studies was that of a very insecure water supply system. Water from the White Volta, some 20 miles distant, was arriving only very intermittently and improvements both by way of more dependable pumping facilities and increased local storage capacity clearly constituted the No. 1 priority.

A long term proposal for the Kaladan Barracks sites and services project for implementation when improved water supplies are secured envisages a restricted water borne sewerage system with local oxidation pond disposal. Such a system would follow the general principles outlined in the Ross Institute bulletin "Rural Sanitation in the Tropics" (Ref. 1) but adapted to suit a suburban rather than a rural environment.

TEMA & ASHAIMAN

Ashaiman comprises an interesting mix of formally laid out streets and haphazard informal development largely although by no means entirely on squatter lines.

Adjacent to Tema, a modern new town, it benefits from a well intentioned municipal authority which however is largely frustrated

in its efforts not only by financial restrictions but in the sort of way mentioned earlier under the heading of maintenance.

The geographical location has facilitated water supply (almost entirely by public stand-pipe) and electricity supply. Despite a modern sewerage system at Tema, in close proximity, Ashaiman's sanitary provision is rudimentary and grossly inadequate. The studies however revealed that the topography of Ashaiman lends itself to a comparatively inexpensive system of shallow sewers which however could only be linked to the existing Tema system at great expense.

The solution devised in this case used two main collecting sewers (more or less one each side of the highest area) each of which could be kept quite shallow whereas a single trunk collector would have involved deep excavation. Each would deliver approximately half the total pollution load to an adjacent site where there would be provided facultative and maturation ponds along the lines described by Mara (Sewage Treatment in Hot Climates - Ref. 2) This solution would permit of ultimate connection to the Tema sewer system should funds become available later.

KUMASI - MOSHIE ZONGO

The most notable feature here is that Moshie Zongo is still comparatively rural in nature and depends upon wells for its water supply. Although piped water will undoubtedly come eventually, appreciable off-site infrastructure costs will be involved. These can only be met if sufficient economy of scale can be achieved i.e. if the cost is shared by many. It is proposed that this should be achieved by the development of sites and services on a site immediately adjoining the proposed upgrading site.

In the meantime the paramount need is to develop sanitary facilities, refuse disposal services and surface water disposal in a way which will not pollute the streams and wells which will remain the only source of drinking water for some time to come.

SEKONDI TAKORADI - KWESIMINTIM

A typical example of non-use of facilities provided but not adequately maintained was noted here where a well designed and well built communal aqua-privy was being shunned by all and sundry who preferred resorting to indiscriminate defaecation rather than facing its unsanitary condition. That condition no doubt arose partially from earlier over-use but could have been prevented with a daily swilling down from a simple hose pipe - and there was a piped water supply quite close to hand!

ACCRA - TESHIE AND NIMA

Land close to the city suitable for new sites and services, as would be expected, is

difficult to find which is why the site eventually selected, north of Teshie is a considerable distance from the city. Apart from the associated problems of travel which result from the selection of this site it presents no insurmountable engineering difficulties. Water and electricity supplies are found within reasonable proximity, gentle slopes facilitate drainage and land for a waste stabilisation pond can be found.

It is however at Nima that the severest problems are encountered and from which some of the most interesting conclusions can be drawn.

The area lies to the north of the Accra ring road, approximately two miles from the city centre. To the east it shares a common boundary with the upper income Kanda Estate; to the west it is separated by the Odaw Stream from the middle income New Town area; and to the north it is limited by the boundary wall of the Accra Girls School and the Achimota Road. The land north of the Achimota Road is a very low density high income housing area.

Nima itself constitutes an extremely crowded densely populated area without room for expansion, surrounded as it is by areas of a very different character.

The very density of Nima however helps to answer at least one of the problems in that, perhaps surprisingly, a water-borne sewerage system proves to be the least expensive of the sanitary options studied, albeit with continued dependence upon communal toilet units.

Surface water drainage is a major problem but improved protection to existing earth channels at key points will provide a vast amelioration.

Existing small dia. water supply pipes, often visible to view, tend, on account of the narrow passageways, to run close to or even actually within grossly polluted drainage channels, constituting an obvious pollution risk in the event of bursts or leakages, and clearly indicate why the provision of piped water to each and every dwelling would be unattainable without unacceptable levels of demolition.

Three alternative refuse disposal systems are recommended for experimental application and a degree of one-way traffic circulation is advocated to enable the satisfactory development of narrow traffic routes.

Cost Recovery

To finance the improvements envisaged it would be necessary to levy a special development charge bringing the total monthly outgoings for most households on rents and rates, development and commodity charges etc. to something of the order of 9% of total household income (or 13% if individually connected to water and sewerage).

Bearing in mind that the project as a whole includes proposals designed to increase the earning capacity of the Client population this does not appear an unreasonable level.

Overall Impressions

In a paper of this length it is impossible to detail all the techniques investigated in the search for inexpensive solutions to problems but we would summarise the most interesting findings of the studies as follows:

There are no universally applicable solutions - each site must be carefully studied and "tailor made" solutions sought.

Whenever there is a choice of site, engineering considerations should feature in the very earliest stages of site selection.

Layouts should take maximum advantage of topographical features and existing infrastructure facilities.

Simplicity is frequently the best solution.

Traffic engineering (e.g. one way circulation) is well worth looking into.

Expensive measures can often be restricted to key points (e.g. concreted bends upon an otherwise earthen drainage channel).

The views of the client population and other interested parties should be sought and respected.

Very impressive results can often be achieved through "economies of scale".

Engineering measures should not be pursued in isolation.

REFERENCES

1. Rural Sanitation in the Tropics. (Bulletin No. 8) published by the Ross Institute, London School of Hygiene and Tropical Medicine.
2. Sewage Treatment in Hot Climates by Duncan Mara, John Wiley & Sons, London.