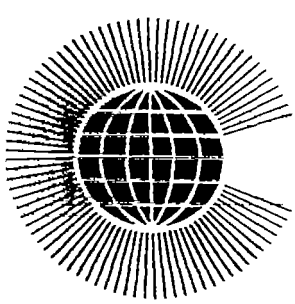
Infrastructure and Training Needs for Sustainable Urban Sanitation in Africa



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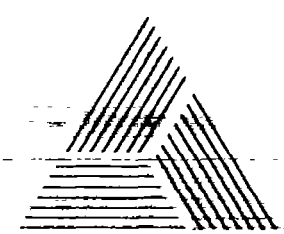

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This report is the output of a study undertaken by the Robens Institute of the University of Surrey on behalf of the Commonwealth Secretariat. A literature review and field visit to Kenya and Ghana were undertaken to access current practice and collect relevant experience. This report is prepared as an overview of the infrastructure and training needs for sustainable urban sanitation in Africa, the style and content of which were discussed and reviewed with the Commonwealth Secretariat.

Foreword

The theme adopted at the meeting of Commonwealth Ministers of Health, in Cyprus in October 1992, was Environment and Health. At the conclusion of that meeting a small number of key proposals were made for action by the Commonwealth Secretariat. These included proposals for regional projects which were based on the participants' perceptions of regional priorities. In the Asia Pacific region development of an effective environmental impact assessment tool was prioritised, while in the Caribbean solid waste management was felt to be the greatest priority. In Africa there are very few towns or cities where sanitation is adequate and the health problems created by poor sanitation continue to be a major cause of illness and death. Hence the topic chosen for the African regions was the *assessment of training and infrastructure needs and development of project proposals for sustainable urban sanitation.*

Early in the preparations for the meeting it had been recognised that the environmental issues of most importance to health were, in general, the responsibility of sectors other than health. During the meeting health sector roles were defined as advocacy for the creation of health; participation in intersectoral collaboration and the development of environmental health work; the participation of local communities and of women at all levels and in all sectors were emphasised.

After checking available expertise in the light of the needs identified by countries of the Africa region, the Commonwealth Secretariat approached the Robens Institute of the University of Surrey and asked them to undertake a study of sustainable sanitation. The study was to result in an overview paper considering infrastructural requirements, institutional roles and training needs. The study should indicate the role of the health sector in the areas under consideration. Arising from this overview they were asked to suggest proposals for action in the region. The Ministers had stressed the need to set clear and achievable goals and targets for such action and determine a definite time frame, preferably within the current triennium.

The findings of the Robens Institute were discussed when a draft was presented to the Secretariat and it was obvious that the study had confirmed the concerns which had led to the original choice of project and underlined the need for sharing of existing knowledge and expertise, particularly in those areas where there is limited documented experience. An annex with specific proposals is being prepared for later circulation.

The intention of this initial study is to help countries identify their training needs and prioritise interventions. The recommendations will emphasis the development of training programmes for public and environmental health staff who will facilitate local authority and community sanitation interventions. During the development of such training programmes consideration will be given to options such as the development of small teams with the necessary technical expertise and health knowledge for undertaking contracts for development or maintenance of urban sanitation; and training programmes for cadres of health workers with the basic skills for practical problem solving at community level. All the personnel trained will be given opportunities to acquire the skills for working with other sectors, non governmental organisations and members of the local community.

In true Commonwealth fashion this study is seen as a catalyst to a process of sharing experience and expertise within the region to the benefit of the people living in urban communities whose health is put at risk by the present lack of adequate sanitation.

K Thairu, Medical Advisor and Director, Health Department, Commonwealth Secretariat.
June 1993

Executive Summary

The need for adequate sanitation in urban areas is a pressing problem and one that must be addressed as a priority because of its importance to public health. Poor sanitation is a significant factor contributing to the high morbidity and mortality rates commonly associated with poor urban areas, particularly amongst infants. Increased access to and use of improved sanitation and water supplies in urban areas will contribute significantly to the reduction in the incidence of disease in the urban population. To achieve this will involve a multi-sectoral approach, in which the health sector should take an important role in sanitation promotion and health education.

When assessing the problems of urban sanitation, particularly provision of services to the urban poor, it is clear that there are a number of factors which influence the sustainability and replicability of programmes of sanitation improvement. Institutional, infrastructural and educational factors will all affect sustainability and replicability and it is important these are addressed preparatory to sanitation programmes.

Institutional strengthening may be required in many countries and the roles that central and local government, external support agencies, non-governmental organisations and the private sector play in urban sanitation defined. Responsibility for construction, operation, maintenance, monitoring and management should be decided at a national level and strategic plans prepared for urban sanitation improvement.

There is in general a shortfall in trained staff at all levels to implement sanitation and health education programmes. If sustainable urban sanitation is to be achieved, there is a need for improved and/or increased education and training of staff working in sanitation. Of particular importance is the development of appropriate educational and training courses within African countries which focus on the real problems affecting each country and which can supply professionals to work in sanitation construction, operation and maintenance. Institutions should be encouraged to develop links with other institutions in the region and elsewhere to increase capacity for training and research.

Technology choice is critical, the introduction of inappropriate technologies in African cities has caused widespread problems of low acceptability, poor maintenance of facilities, frequent breakdowns and limited repair work. Technologies should be identified which provide a health benefit, are affordable, acceptable and can offer, where appropriate, a significant level of community based operation, maintenance and management.

Realistic charges for sanitation facilities must be levied if sanitation programmes are to be sustainable. Where incomes are low, sanitation programmes in African countries should aim to empower low-income groups to accept an increased level of responsibility for the management of sanitation facilities. If health benefits from improved sanitation are to be realised, it is important that good hygiene practices are adopted by the population. To facilitate this, health education programmes run in parallel to construction programmes are required. This will generally be the responsibility of the health sector, but is likely to require input from other sectors. The provision of community health education with particular emphasis on sanitation and good hygiene practice is vital to ensure that once facilities are available they are used and maintained properly.

The health sector has an important role to play in urban sanitation and should develop a coherent approach to the health problems associated with poor sanitation. The provision of health education in parallel with construction, inputs to higher and further education courses in public health-related disciplines and the establishment and monitoring of effluent and waste quality are all likely to fall within the health sector remit. Where the sector does not have the necessary expertise to fulfil all these roles, then cooperation with other sectors, such as education and local government will be particularly important.

Much literature is available concerning technologies for urban sanitation, some texts of particular use are listed in Annex 2. However, information regarding training strategies and institutional strengthening is limited and problematic to locate. Dissemination and exchange of information concerning strategies and implementation of training for staff and communities on a national and regional basis would greatly assist the development of institutional and training capacity within Africa and should be encouraged.

Contents

Introduction

The urban population of Africa has increased dramatically over the past two decades through high birth rates in urban populations and continuing migration from rural areas. The majority of the urban population of Africa are in low-income groups, with generally sub-standard housing, few basic services and poor infrastructure. A large proportion of the urban poor live in informal settlements on the fringes of cities or in overcrowded inner city areas.

Generally, the provision of adequate water supply and sanitation has not kept up with the increase in population in African cities, and coverage is particularly low in poorer areas. The problems to the health of the population that this has caused have been massive. The lack of basic sanitation in low income areas is one of the principal causes of the high rates of morbidity and mortality commonly associated with these areas. This is primarily due to the high incidence of 'faecal-oral' route diseases which include diarrhoeas, dysentries, cholera, typhoid and viral diseases such as infectious hepatitis. Other diseases which thrive in these areas are vector-borne such as filariasis and malaria (related to inadequate sullage disposal and urban drainage) and helminth infections due to poor excreta disposal (worm infections such as roundworm and hookworm are often more common in cities than rural areas). With the high density of population in most low-income urban settlement there is always a risk of epidemics where sanitation and water supply are poor.

In the recent past engineers and planners have concentrated on conventional sewerage as the only viable solution for urban sanitation. This requires an in-house level of water service, complex and sophisticated designs and materials and sophisticated operation and maintenance regimes carried out by skilled staff. Sewerage isolates fresh excreta from the user but transfers the hazard to another site where it will require treatment. All these factors greatly increases the cost of sewerage to the point where - unless the municipal authorities can subsidise the provision of sewerage - only a wealthy minority will be able to pay for sewerage services. Most municipal authorities or governments in Africa are not in the position to provide subsidies of the scale required for large scale introduction of sewerage. It may also not be technically feasible in many of the informal low-income areas in inner cities and on the periphery of cities as water supply levels are low, the supply may be discontinous, housing is temporary and access commonly poor.

If the health of the urban poor in developing countries, and in particular within African cities, is to be improved there is an urgent need for large scale investment in improved sanitation which utilises technology which is affordable, provides a health benefit, cam be sutained and gives users convenience and privacy. It is imperative that municipal authorities and governments in Africa look at the full the full range of technologies available to them and choose lower cost options which will allow a greater role for community participation and management of sanitation facilities.

In conjunction with technology provision there is a need for health education in the community to promote good hygiene and the need for proper disposal of human wastes. For a significant health benefit to be realised sanitation facilities must be used correctly and good hygiene practiced to prevent the transmission of faecal-oral diseases. The training needs of communities need careful evaluation, particularly if increased community management is a goal of the national sanitation plan.

The lack of trained staff and the level of general education amongst the urban poor are also hampering the improvement of sanitary conditions in African cities. Governments need to identify national training needs for staff involved in sanitation provision such as engineers, technicians, health education staff and planners. A clear strategy to satisfy these training needs should be developed and the national training capacity increased.

Hygiene education, technical training in operation and maintenance and support for management structures will all need to be addressed if sanitation provision in urban areas is to be sustainable.

Institutional Roles

Requirements and Key Players

There is a great need in most African countries to increase the institutional capacity to support the development and sustainability of urban sanitation programmes. The strength of institutions on a regional and national level needs to be increased to allow governments and municipal authorities to plan more effectively and manage existing and future sanitation facilities efficiently and cost-effectively. Staff need to be kept abreast of current developments within the field and research capabilities should be strengthened to improve the range of available technologies, to increase affordability of technologies and to ensure that adequate 'delivery' systems are developed and refined.

There are a number of Government departments who are likely to be involved in some way with sanitation programmes, although these will vary according to national and local arrangements. These include: the Ministry of Health; Ministry of Local Government; Municipal Authorities; Ministry of Works; Ministry of Finance; Ministry of Water; and, the Ministry of Education. In addition to these government agencies, there are a number of other interested groups who are also involved in sanitation improvement. These are likely to include educational institutions; multi-lateral and bi-lateral aid agencies; UN agencies; and international and national Non-Governmental Organisations (NGOs).

The recipient communities are not strictly an 'institution', but the aim of increasing national institutional capacity should be to improve the health of each community and the overall population. Thus increasing the capacity for communities to make decisions and promote change is vital. It is important to recognise that the strengthening of the community capacity is vital in the developmental process.

The role each player or institution takes in sanitation provision will vary between countries; responsibilities are not always clear cut and there is often of overlap between sectors. Some recommendations for the roles for individual sectors are outlined later in this section, but general principles are noted here.

The management and/or construction of sanitation facilities may be supported by a number of sectors. In some cases, the municipal authority will be responsible for the construction and management of sanitation programmes, although these are commonly funded either by an external support agency and/or national Government. For example, in Nairobi the Municipal Authority is responsible for all sanitation provision within the city. Alternatively the Municipal authority may try to redefine its role within sanitation provision to that of monitoring and management. An example of this approach is development of a strategic sanitation plan and implementation of the pilot projects in the Kumasi Metropolitan Area (KMA) in Northern Ghana which was implemented by the KMA and supported by UNDP-World Bank. This project encouraged active participation of the private sector in a number of areas of the programme and the Strategic Sanitation Plan that was produced recommended that the private sector role in construction and desludging be expanded.

Municipal authorities and Ministries of Local Government may be able to provide technical input to sanitation programmes as they commonly employ some qualified and experienced staff. However, resources for material and equipment purchase and for on-going operation and maintenance are often limited. This is partly due to limited national resources, but often also due to poor management and a lack of active campaigning for resources at a national level. The local government sector is also often poorly equipped to deal with health education programmes as they may not have much experience of providing health education or have staff who can implement such programmes.

The health sector may be actively involved in urban sanitation programmes, but in many African countries the health sector has adopted a low profile with regard to sanitation provision as a whole and urban sanitation in particular. Whilst the health sector has made some contribution to the planning of sanitation improvement at a national level, urban sanitation provision has largely been perceived as a local government responsibility and the health sector has therefore not been directly involved. Health sector involvement in urban sanitation provision has also been hampered by a lack of sufficient resources to meet all the demands made upon the sector.

As sanitation has often been perceived as an engineering problem and as few African health departments have engineers on their staff, the provision of urban sanitation has been relegated to a position of minor importance by the health sector. This is a weakness in the sector and, although it is unlikely that the health sector will become actively involved in construction of sanitation facilities on a large scale, recruitment of a small number of public health scientists and sanitary engineers would greatly assist the sector in playing a more active role in the planning and implementation of urban sanitation. This would allow the health sector to be able to develop and conduct more thorough monitoring programmes, make a significant contribution to the national and local planning of sanitation improvement programmes and be able to assess health benefits of technologies more comprehensively.

The main role currently the health sector plays in sanitation provision is through health education, environmental health inspections and training of community health workers. This is largely the approach adopted by the Ministry of Health in Ghana. The health sector should continue to strengthen and expand its role in health education, training and monitoring. The sector should play a proactive promotional role to raise awareness about the importance of sanitation in urban areas in communities and governments.

The strength of the health sector lies in its understanding of the health issues related to poor sanitation. This expertise should be exploited to develop appropriate health education programmes in communities, in actively promoting the benefits of good sanitation and hygiene to the population and by establishing adequate effluent and waste quality standards and surveillance.

The education sector has been involved in urban sanitation through the provision of formal education through higher and further education institutions and schools. Generally the education sector has a substantial resource in the number of trained teachers of all levels. However, public and environmental health education has not generally been afforded a high priority by the education sector and is still restricted to a small number of specialist groups, although there have been some innovative approaches such as the MSc course in Public Health Engineering offered to medical staff by the University of Nairobi.

In many African countries the education sector also provides a limited input to the informal training of communities and field staff. This has commonly been in the form of workshops and in-service training to field staff and functional literacy programmes aimed at adults and non-schooling children. However, informal education for adults and children who have left school is still generally weak in most African countries and, whilst it's importance is widely recognised, few education departments have committed substantial resources to informal education. By improving collaborative links with External Support Agencies (ESAs), NGOs and other government departments, the education sector's capacity for informal education could be increased and should have some focus on sanitation.

The finance sector of national government is important to sanitation as ultimately it will allocate resources for sanitation improvement. This sector should be aware of the general benefit, both in health and potential income generating capacity, to the population that improved sanitation can bring. They should also be involved in policy making and technology selection to ensure that the economic costs and benefits are properly addressed at a national level.

External support agencies (ESAs) and NGOs are both actively involved in urban sanitation programmes and can make significant contributions to the development of sustainable programmes. External support agencies have generally focussed on the support of other agencies, such as municipal authorities and NGOs who implement projects. For instance Unicef and DANIDA amongst others have provided considerable support for the Kenya Water for Health Organisation (KWAHO), a national NGO, who run several projects in low-income urban areas in Kenya.

ESAs commonly also support institutional capacity building projects which strengthen training and education for sanitation programmes. For example, the United Kingdom Overseas Development Administration have supported the development of a public environmental health programme which aims to train public health inspectors and health educators in Kumasi, Ghana.

National Policy and Inter-sectoral Collaboration

At a national level, strategic plans for the improvement of urban sanitation should be developed which clearly identify the national goals for health in relation to improved sanitation. This should include discussion of the expected health benefits to the population. Some attempt should be made to quantify the cost to the national health services caused by sanitation related diseases; some projection of productivity losses through work days lost caused by sanitation related disease; and the expected effect of improved sanitation on these figures.

This plan should also clearly state what the national cost of sanitation provision will be, what external funds will be required, how costs can be shared between the government and the users and what commitment will be made to meet long term operation and maintenance costs. It is important that time limits are established to meet interim and final objectives.

The national plan should provide guidelines to municipal authorities on: technology selection; programme implementation; who should be responsible for construction; time scales for implementation; cost recovery plans; community health education programmes; staff training needs and provision; and, planning for long-term monitoring and support of community based sanitation programmes. This will involve an inter-sectoral approach and urban sanitation provision should be established as a key component of the overall development strategy of the country.

A forum for information exchange should be established which should include representatives of all the major players in sanitation provision including appropriate government department or Ministries, ESAs, NGOs and educational institutions. By involving all the main players in the planning process it is more likely that the results will be more widely supported and accepted and that the needs of those who will ultimately benefit from improved sanitation will adequately addressed.

Regular meetings of all sectors should be held at a senior level, for instance through an inter-Ministerial committee, and a body set up to plan and monitor on a national scale urban sanitation programmes. This body may be the above committee or a sub-committee and should have the weight to achieve change and not be allowed to become marginalised through lack of political power. To this end the committee or body should include senior representatives of all interested parties such as Permanent Secretaries, senior Municipal officials and possibly representatives of ESAs or NGOs acting in an advisory capacity. The recommendations made by such a body should form the basis of policy for urban sanitation and be used to develop long-term and short-term aims and objectives.

This committee should be responsible for: assigning sector responsibilities; establishing investment priorities; identifying sector weaknesses and promote strengthening of the sectors involved in urban sanitation; establishing a panel to identify appropriate technologies for urban conditions; how costs may be recovered from users; whether subsidies are required and to what level; and, what complimentary education programmes should be run in conjunction with construction programmes. Guidelines for quality standards of effluent and treated waste and reuse of treated waste from all sources proposed by the health sector should be discussed and standards approved at this level. This forum need not be technical but should be able to call upon technical committees to address specific issues and produce clear results and recommendations.

To ensure that implementation of improved urban sanitation is effective, one agency should take the lead in planning and supervising programmes of sanitation improvement even where these are implemented by the private sector. In most circumstances the most appropriate body for this will be the Ministry of Local Government, or its equivalent, and the municipal authorities. These agencies are the most involved in urban affairs and it is they who should retain overall control of urban sanitation improvement on a local level. However, this does not mean that the other sectors should rely the lead agency to be solely responsible for promoting sanitation programmes. All sectors should be actively involved to ensure that the key issues are addressed and that urban sanitation maintains a high profile in government policy.

A national panel or working party should be responsible for the evaluation of technologies on the basis of technical, health benefit, social acceptability and cost criteria and make recommendations to the inter-sectoral committee. This panel should include an engineer to assess technical suitability; a health professional to assess the health benefit to the users; an economist to provide a thorough cost-benefit analysis of each technology, taking into account the

long-term benefits to the economy as a whole in terms of expected lower health care costs and improved productivity; an educationalist to assess the training needs associated with each technology; and, a social behaviourist to look at social and cultural factors of technology suitability.

Conducting a thorough review of all available technologies in such a 'holistic' manner should avoid future problems such as a technology being selected that is technically feasible and cheap but culturally inappropriate, with limited health benefit and/or with a high education requirement for proper use. Technologies should be identified which provide the maximum health benefit, are technically feasible, low-cost, culturally acceptable and with the minimum training required for proper use.

The routine monitoring of effluent and solid waste should be an integral part of any urban sanitation programme to protect the environmental and public health of the population of cities and also other communities downstream of discharges. Appropriate, achievable quality standards should be established, however, it is important that the standards adopted are designed for the maximum protection of environmental and public health and backed with the legal mechanisms to enforce compliance. A fully independent national body should be established to take responsibility for routine monitoring of waste and discharge quality. This could be a health sector or an environment sector role.

Individual Sector Roles

Individual Ministries, educational institutions and external agencies all have different roles to play in urban sanitation improvement, which taken as a whole should ensure that key issues are adequately addressed.

Local Government:
This is commonly the lead agency promoting urban sanitation, as is the case in Kenya for example, and should be responsible for the planning and implementation of programmes. Local government should be responsible for recommending how programmes should be implemented, what technologies are to be used and who should be responsible for construction, operation and maintenance. If private contractors and NGOs are to be involved in sanitation provision the Ministry of Local Government and municipal authorities should clearly define what standards of construction are required, how different contractors and organisations should be involved and how sanitation should be promoted in the community. They must also decide what their own role should be in sanitation provision and produce a clear plan of how this will be achieved.

Local government, with the assistance of other sectors, should be responsible for the development of municipal sanitation plans which have a strong strategic element to them. These plans should outline time scales, technologies, pilot projects, education and training needs and costs of sanitation provision. Municipal authorities should also produce comprehensive annual reports on the progress of work, amend plans in light of these and highlight any major problems which have arisen and state how these will be addressed.

Local government should therefore provide a focus for urban sanitation provision and promote sanitation as a priority intervention in the development of urban centres. It may be that local government will also take responsibility for the management of sewerage and sewage treatment and for some areas of sanitation construction, for instance in public places such as markets and industrial areas. It may also be responsible for the emptying of pit latrines and septic tanks. Adequate resources will be required to fulfil these functions.

When construction, desludging and treatment are not the direct responsibility of local government, it should have the capacity to establish working guidelines to ensure proper management of sanitation in the city. These should cover: construction quality; ensuring affordability of facility construction; ensuring that good working practices are adopted (in particular health and safety at work); and, for monitoring the activities and performance of implementing agencies.

If the private sector is involved in construction of sanitation infrastructure, the municipal authority should keep a register of approved contractors who are licensed to submit tenders for construction programmes. These contractors should be evaluated in terms of technical ability, financial viability and on past record of contract management. Approved contractors do not necessarily have to be large companies - a register should ideally also include small businesses and local artisans who can work within their own communities.

Municipal authorities are often responsible for

sanitation in hospitals, schools and other institutions. Even where local government is not directly responsible it should actively promote sanitation in these institutions and consider making their provision a statutory requirement for all institutions, as was recommended in the Kumasi Strategic Sanitation Plan. Local government may also consider whether public institutions should receive a greater level of subsidy than is generally available for sanitation improvement.

Health Sector:
The health sector has an important role to play in urban sanitation at both national and local level. The health sector should be actively involved in producing national and municipal strategic plans for sanitation improvement and should be directly responsible for the provision of community health education. The health sector should also work with educational institutions to establish and strengthen courses in public health, including engineering and technical disciplines as well as health education. The health sector should also be involved in the establishment of adequate effluent quality standards and may take responsibility for surveillance of discharges and monitoring and evaluation of sanitation improvement.

The health sector should be a strong advocate of urban sanitation improvement and take a proactive role in the promotion of sanitation improvement. The sector should recognise the profound influence that poor sanitation has on the health of the urban population and accept a high profile role in sanitation promotion and health education. A high proportion of the diseases commonly encountered in developing countries, particularly in low-income urban areas, can be directly related to inadequate sanitation facilities and water supply. As the health sector is responsible for the prevention and treatment of these diseases it makes sense that they should be actively promoting improved sanitation and water supply as key issues for the health of the population. This is already happening in some African countries, for instance in Ghana.

It is not generally recommended that the health sector become directly involved in the construction of sanitation facilities as there are generally few technical staff employed in the sector and it would be inappropriate for the sector to duplicate the capacity of other sectors. However, it would increase the capacity of the health sector to promote sanitation at a local and national level if some engineering and scientific staff were employed. However, the most important role for the health sector is the training of health and other sector professionals to ensure that those concerned with sanitation provision have a clear understanding of the health issues involved.

The health sector should take responsibility for providing community health education in parallel with sanitation construction programmes. This means that there should be substantial intersectoral cooperation at a municipal level as well as at a national policy making level. Health education programmes must be linked to construction programmes and the two seen as essential and complementary. To achieve this the health sector should be a key participant in the planning process when setting construction targets and plans for sanitation implementation. No construction should go ahead where inadequate resources exist for complementary community health education. In urban areas the need for health education is often as great as the need for sanitation facilities.

Collaboration with the education sector may be increased to develop appropriate education techniques and materials for community health education programmes. This may be useful as there is often useful expertise in the development of education strategies, appropriate informal education techniques and materials within the education sector.

The health sector should promote collaboration between projects and agencies involved in health education both locally and nationally to ensure that high quality materials are available to all interested parties. There are often several agencies developing health education programmes and materials which may have little contact with each other. This may lead to multiplication of materials and a wide variation in the quality of teaching and materials used. A regular forum should be established for the appropriate bodies, be they institutions, aid agencies or municipal departments, to allow the latest developments to be disseminated and discussed and to encourage inter-agency cooperation.

The health sector should work with higher and further education institutions to ensure that courses offered which are relevant to public health and in particular sanitation, have adequate coverage of health aspects, including basic germ theory, epidemiology, basic microbiology, the barriers to disease transmission and sociology or studies of human behaviour. The sector should work with teaching institutions to develop their curricula to cover these topics and provide advice on teaching

materials development and where necessary provide a teaching input into such courses. Courses where a substantial health sector input will be required are: sanitary engineering; undergraduate civil, mechanical and chemical engineering courses in public health engineering options; public health science; diplomas in environmental health; technician training; community health education courses; courses for programme managers and plant managers etc,

A substantial input will be required from the health sector in the assessment of technologies for urban sanitation and waste treatment to ensure that appropriate technologies are selected which provide the maximum health benefit to the urban population.

The health sector may be the lead agency in the establishment of quality standards for effluent and treated waste quality from both domestic and industrial sources. This is to ensure that - in addition to environmental protection - the health of the population is protected. These standards should address both the short-term effects of pathogenic contamination of natural waters and toxic waste from industry, and the long term health effects of exposure to harmful chemicals. The health sector may also be an appropriate body to take responsibility for surveillance or contribute expertise to a statutory body established for this.

The health sector should monitor uptake and use of sanitation facilities by all sections of the community and to evaluate the impact on health that this effects and use this information to define research needs in urban sanitation. Research into the links between the improvement of urban sanitation and improvements in health is recognised to be a difficult areas but is important and a function which the health sector may fulfil, possibly in collaboration with institutions of higher education. Where this research is undertaken, it should attempt not only to give an overall picture of the effect of improved urban sanitation on health, but also highlight which specific areas contribute the most to health improvement and identify areas which require further development to provide a significant health improvement. Thus the individual effects of facility provision, health education, educational status, financial status and cultural factors (such as age, sex, religion etc) should be considered. This will require inputs from other sectors, for instance social science and education.

Education Sector:
The education sector should be a key player in urban sanitation as it is likely to be involved in the formal and informal education of the population, particularly children. It is also likely to have some involvement in the training of field staff and professionals. Where the education sector can take a proactive role in the development of suitable training programmes and courses relevant to sanitation, then the delivery of such training is likely to be more efficient and effective as staff with educational training will be involved. The education sector needs to work closely with other sectors to identify training needs and develop appropriate education and training strategies for the sanitation sector.

The education sector should work with the health sector to develop appropriate higher education for students studying for degrees, diplomas and certificated courses in community health education. The health sector can best advise the education sector what subjects should be covered, but the education sector may be best able to advise regarding how these should be presented for the students to gain the maximum practical benefit. This last point is important because students need to learn skills and techniques which will help them on graduation to provide an acceptable quality of work on sanitation projects. Highly theoretical courses alone will not adequately prepare graduates for the working environment and often result in a heavier training burden being placed on employers.

Contact between education providers and employers should be encouraged to ensure that the graduates of appropriate courses have skills which correspond to the needs of the employers. Obviously, students will require some theoretical background but the principal focus, particularly in diploma and certificate courses, should be the practical solution of real problems encountered within the country.

The education sector should be involved in community health education and assist the health sector to develop appropriate participative methods of teaching methods and the development of appropriate teaching materials. Health education programmes should be seen as collaborative ventures between both sectors and they should work as a team to produce the best results possible.

Cooperation is also important between the local government sector and the education sector to develop appropriate courses of higher and further education. The education sector should work with engineers, technical staff and scientists to identify training needs, set up courses for students at degree, diploma and certificate level and collaborate in

developing appropriate in-service training for staff. Again the focus should be on the practical solution to real problems found within the country's urban areas with a lower emphasis on theoretical content, except on degree courses. All technical, engineering and scientific staff who will be trainers should be trained in education techniques to ensure that the training they provide is of high quality. This should be implemented at all levels, from degree courses to local mason trainers.

Institutions of higher education should look at ways to collaborate in research and teaching with the sectors involved in sanitation. Universities, colleges and other teaching institutions which offer higher and further education in relevant subjects should increase their capacity to collaborate with other institutions in-country, regionally and globally. This should be a two-way process with teaching institutions in individual countries sharing their expertise and knowledge with others regionally and globally whilst being able to access expertise themselves. Networking can be beneficial to all participating institutions facilitating the development of teaching and research capacity. Of particular benefit is networking between institutions in the developing world to exchange expertise and experience of common problems and potential solutions. This should not be restricted to regional networking but also include networking with institutions in other regions of the developing world. For example, African teaching institutions should consider strengthening and expanding their links with appropriate institutions in Asia and Latin America.

ESAs and NGOs:
These can play a vital role in providing funding, expertise and, sometimes, management of implementation of sanitation programmes. These agencies can also act as catalysts for change and promote the importance of sanitation on a national and international level. ESAs are often responsible for funding of programmes of sanitation provision or training of staff in government or municipal authority employ. Many of the larger urban sanitation projects, such as the UNDP-World Bank funded KMA project are funded in part or entirely by ESAs.

Increasingly ESAs are providing funds for NGOs whether national or international, to implement sanitation programmes. This is because many NGOs have a good reputation for working with the poorest sections of society, of running participative programmes and being cost-effective.

Both ESAs and international NGOs have their own training and institutional development policies. They usually have access to expertise either in-country or from expatriates with appropriate skills and experience. Many international NGOs and UN agencies attract skilled and educated staff within countries and this is beneficial in that they remain within the country and continue to work in sanitation. Some governments, for instance in Sierra Leone, assign staff to NGOs as this allows the Civil Service to retain good staff with limited financial cost, provides a good career development experience and ensures that government will in the future have staff that are familiar with sanitation designs and means of operation and maintenance.

National NGOs also attract significant external support, for instance KWAHO has support from Unicef and DANIDA amongst others. These agencies may represent good investment in community development as they are likely have a long-term input into the community. They may require institutional strengthening through training in management techniques and accountancy, as well as appropriate technical, teaching and mobilisation skill development. This training will require some input from the health sector, particularly training for health education staff and health training for managers and technical staff.

Private sector:
Private constructors may be responsible for some or all of the construction, operation and maintenance of sanitation facilities. Much of the private sector role may be fulfilled by small contractors, for instance local masons, working within particular urban areas and often in a locally restricted area within their community. Where private contractors are employed they should be able to demonstrate technical capability, financial security and preferably, a record of successful contract completion.

Private sector activities will benefit from a good understanding of the health benefits of sanitation and flexibility in their approach to sanitation construction. The private sector would also benefit from training by the health sector in community mobilisation techniques.

The community:
Whilst it is not strictly accurate to define the community as an institution, it is clear that in any programme of urban sanitation improvement should be geared to the improvement of health of the population. As the health of the population improves

this may help to improve social and economic conditions as people have more time and energy to devote to economic activities.

The community needs to be in the position where they can make rational decisions when a choice is available. This is particularly important when communities are expected to choose which sanitation technology they require, as this process will involve assessing complex issues and making value judgments. Although communities already possess a wealth of knowledge, this may not be focussed on sanitation issues and communities may not fully appreciate the health benefits technologies provide and what inputs the community are expected to provide.

The role of women in technology choice and in health education should be promoted by all sectors involved in urban sanitation programmes. Women often make very effective hygiene educators as the largest part of the target audience is often other women and children. However, this should not be seen as women's sole role in sanitation provision. They should be actively involved in technology choice, programme implementation and, most importantly, management of sanitation facilities. Women should be encouraged to take initiatives and not allowed to become passive partners to male decision makers. This is an issue which must be handled sensitively by all concerned with sanitation and appropriate methods of promoting womens role in sanitation provision developed.

Where sanitation improvement will involve a significant element of community management, training and strengthening of community institutions is often required. This is clearly seen in the KWAHO project in Kibera, Nairobi, where institutional strengthening was seen as a priority. As this is a low-income, informal settlement with few basic services supplied the community has had to accept responsibility for many of the management decisions. This includes establishing a revolving fund which can be used to provide loans for those households who wish to dig latrines, setting in place a rotational system for pit exhausting, allocation of latrines for exhaustion for each day of operation, organisation of clean-up days and solid waste disposal. To achieve this level of organisation, communities require support for committee members and training in areas such as simple book-keeping.

Increasing the capacity of the community to train their members will greatly assist in making sanitation and health education programmes sustainable. Ultimately, if sanitation programmes are to be sustainable, the community should themselves be able to continue the construction of facilities to keep up with population increase and provide on-going health education, under the overall supervision of local municipal authorities, with minimal external input. This means that sanitation should be viewed as an essential basic service by the community, that skills exist in the community to construct and maintain facilities and that on-going health education is provided through parents, community health workers, schools and other community organisations. To achieve this often requires extensive training and community management capacity building and support to establish and strengthen community structures which allow all sections of the community to be actively involved in decision making.

Training Needs and Provision

Introduction

In order that the health benefits which accrue from improved urban sanitation are realised, users and providers need to be fully aware of the health issues related to sanitation, how to construct and use facilities correctly and to adopt good hygiene practice. It is important that all those concerned with the provision and use of sanitation facilities understand *why* sanitation is important as well as *how* sanitation can be improved. This is emphasised because it is quite common that technical professionals such as engineers, builders and supervisors have little grasp of the health benefit of the work they are engaged in, which can lead to inappropriate allocation of resources. The rationale behind any programme of sanitation improvement should be to improve the health and well-being of the population. In order to optimise the health benefits that accrue from sanitation improvement, designs for sanitation facilities should prepared with the health aspects of design considered from the outset and not concentrate solely on technical considerations.

The construction of sanitation facilities is not in itself sufficient to provide a health benefit to the user; the proper use of the facility and the adoption of good hygiene practices, such as handwashing after defecation and before eating, are vital for health improvements. In many areas within cities, particularly amongst low-income groups with limited access to education, there is a great need for health education to promote improved hygiene practices.

The principal providers of training and education for urban sanitation are likely to be:

> Δ the health sector - through development of community health education programmes, input to relevant courses of higher and further education including public health engineering, public health science and community health education; providing an input in the development of courses and educational materials for school hygiene education; the development of teaching aids and in-service training to environmental health officers, health inspectors, community health promoters, medical and other health staff;
>
> Δ the education sector - through the provision of relevant courses in institutes of higher and further education, development of health and hygiene education curricula for schools and development of teaching materials;
>
> Δ ESAs and NGOs - through technical and financial support for education and training strategy development and implementation; and through direct involvement in implementation.

The capacity for providing higher education in public health in developing countries needs to be increased as typically few courses in appropriate subjects are available in national institutions in African nations. Commonly, a select few are sent to developed countries to attend study courses. As a result few professional staff have access to higher training and there is commonly a shortfall in expertise. For instance, there are relatively few practising sanitary engineers in Africa in government employment and the same is true for many other disciplines.

A common problem is that once a member of staff has gained a further qualification outside the country they become more marketable in the private sector. It is quite common for government staff go to a developed country to study for a higher degree and on their return leave the government service soon after their return in order to pursue a career in the private sector or outside their own country which may be financially more rewarding or have better career prospects. If these professionals remain within their country and work in sanitation within the private sector they will still be contributing to the overall development of their country. However, it is commonly the case that such individuals work outside their country and not always in a relevant field. This leads to a 'brain-drain' within government structures and can result in vicious circle of sending staff overseas for training and losing them rapidly on their return. If more staff are trained in-country to a high level, government will have more staff available and the 'brain-drain' may be manageable.

It is important to establish career structures within government bodies if good staff are to be retained. These should be used to encourage staff to remain in

the sector by offering progression to higher grades and the prospect of further training. Of particular importance is to ensure that those staff who are supported to study at a higher level have challenging work which is relevant to the subject of their studies to come back to at the end of the course. By immediately utilising their new knowledge and by given greater responsibility in recognition of the value of their education, staff are likely to feel more motivated and more inclined to remain in the government sector.

Education and Training Strategy

There are a number of groups for whom training is required, from engineering and planning staff employed by national government, municipal authorities or other agencies through field staff to community members. It is important that for each group a thorough training needs assessment is carried out to identify what training is required. A national strategy for training should be developed which identifies who should be trained, in what, where, how and by whom.

Courses in appropriate subjects should be developed in African countries and should include training for field staff and courses leading to certificates, diplomas and degrees for suitable candidates. This means that a national human resource development strategy should be produced which caters for the needs for all staff and community members and not just academic elites. It is important that entry requirements for such courses are not relaxed simply to boost numbers, rather the courses should attract high calibre students and give high calibre training.

Mechanisms should be put in place to allow able students to carry on through the education system. Thus, an individual who has a technical or trade qualification but who is deemed suitable, should be to proceed eventually to a degree course without requiring further school certificates. Also mature students with possibly limited formal education but with extensive experience should be encouraged to return to formal education at a higher level, for instance to a diploma course and potentially a degree course.

Part-time, modular and block release courses may be particularly appropriate in all disciplines to encourage able members of staff to increase their education and so their value to sanitation programmes. Courses should retain a practical basis and relate to real conditions in the country and region, with the use of existing projects and sanitation systems as case studies.

Each country should develop and strengthen existing education and training centres which offer courses in relevant subjects, such as public health engineering or community health education. Where these are few or do not exist, consideration should be given to establishing new centres which focus on the needs of the country. Decentralisation of educational institutions is also important, so that it is not only the capital cities or very large towns who have facilities to provide public and environmental health education. Graduates of courses should be able to develop their careers in smaller towns, particularly where these are in poorer areas of the country or which have severe health problems, thereby discouraging the view that the capital city is the only place in which to develop a career.

Institutions in African countries should be encouraged to establish links with other educational institutions to encourage co-operation and collaboration in sanitation improvement between nations. The UNDP-World Bank International Training Network is one option already available for suitable institutions and wherever appropriate, efforts should be made to link into this network. Regional networking has advantages. Adjacent countries may have different fields of expertise and this knowledge can then be shared with other countries who possibly have greater expertise in another field. Visiting fellowships and exchange studentships can also help to build links and assist countries to develop their national institutional capacity.

However, consideration should also be given establishing links with institutions in other areas of the developing world and with institutions from developed countries. The expertise available in these institutions and the different experiences from different parts of the developing world, may help African institutions to improve implementation, education and research capabilities. The development of curricula will also be enhanced through co-operation with other institutions in developing countries and institutions in developed countries.

At least in the short term, some students will have to receive education outside their own country until the structures are in place to provide this locally. Students who study abroad and particularly those taking higher degrees should, amongst their other roles, be utilised to train others in the country where

this is appropriate. For instance, they may be able to contribute to teaching of undergraduate engineers, or help to devise practical projects and case studies for local institutions. This can act as an incentive for staff to remain in government employment, particularly if they are paid for their time.

Institutions which wish to provide higher education in fields related to sanitation, must have sufficient expertise and experience either in-house, or easily accessible to the institution to make them effective. A key priority is the training of trainers to ensure that all institutions which offer relevant subjects have adequate expertise in their field and as teachers. This is important as it is potentially more harmful to have courses where the teaching personnel do not have sufficient knowledge and who may pass on inaccurate information than to have no courses available at all.

Sanitation and public health related topics must be interesting and attractive to students in order to encourage good students to study them and develop a career within the sector. A recent survey of civil engineering students at Addis Ababa University in Ethiopia showed that only one per cent were interested in working in sanitation compared to 80 per cent who wanted to be structural engineers. However, 90 per cent cited improved sanitation as the field which would bring about the greatest improvement in the quality of life. Unless sanitation can attract a greater number of high calibre personnel, the sector will remain inadequately staffed.

Degree courses in public health should not be restricted to engineering disciplines, but also include community education, health and management. Courses which provide training in community education and community mobilisation are as important as hard engineering courses. Staff from all disciplines should be given training in the basics of the other disciplines, for instance at the University of Nairobi there is a Masters course in public health engineering for medical staff. Furthermore, in an increasing number of colleges, engineers are given the opportunity to learn about other aspects of public health such as epidemiology, basic microbiology and community education techniques. This should be encouraged and practised more widely.

A summary of the issues to be addressed when developing a national strategy for education and training is given in Annex 1.

Training Needs Assessment

The process of definition of training needs and the development of appropriate training strategies should be interactive with all the interested parties actively involved throughout the process from inception, through implementation to evaluation and review. The people who are actually to be trained should be consulted to establish what knowledge they already have and what training they feel they want or require. Managers and senior staff should also be consulted concerning what training they feel is needed by junior staff. However, these recommendations should not be allowed to becomes the deciding factor as these may have been distorted by personal objectives. For training to be successful the trainees themselves should recognise the need for training and feel that the training provided is appropriate and meets their needs.

Where courses of higher or further education are being set up in teaching institutions, the provincial and country needs for training in the sanitation field should be assessed and curricula developed which will satisfy these needs.

In-service training for sanitation staff should be focussed on specific topics and build on existing knowledge. The assessment of in-service training needs can be established through annual staff appraisals, discussions and observation.

Community training needs can be ascertained through discussion with the community, baseline surveys and observations. The type of training and the subject matter covered in community training is vital for the sustainability of sanitation interventions. If communities do not understand the need for sanitation and how facilities should be used to help improve health, the health benefits expected from improved sanitation are unlikely to materialise.

Where assistance from external donors for training is anticipated, they should ideally be involved in training needs assessment to encourage their involvement and facilitate allocation of resources where they will be most effective. However, it should be the national and local government and the people of the country and not the donors who determine training strategies.

Staffing

The people involved with sanitation programmes are likely to come from different backgrounds and will be responsible for different aspects of sanitation programmes. Specialists will always be required to perform certain activities, for instance an engineer will be required to design sanitation facilities, and a scientist to test effluent quality. However, it advisable that all staff have at least some idea of what their colleagues do. This helps to ease tensions that may exist between different groups and fosters team spirit.

There is important role for staff who have a wide range of skills which they can share with the community. This is particularly true of field staff who may need to be able to provide health education, construct simple sanitation facilities, carry out sanitary and health inspections and train members of the community to do some or all of these tasks. These staff are equivalent to environmental health officers (EHO's).

There are a variety of groups who will benefit from training in small business practice, management and accounting. These obviously include local artisans who may require further training in order to be efficient but will also include those studying for a technical qualification and, potentially, those studying to be environmental health officers. In the case of local artisans these skills may be passed on through a series of short workshops and courses which are highly practical and allow them to focus on their particular trade. Students who are taking technical courses may have small business management courses offered as an option during their course. For those students training to become environmental health officer, it may be most appropriate to offer short courses in small business management training after they have achieved their qualification.

The different groups involved in sanitation provision have differing training needs and these are outlined below the following broad categories:

- Δ engineering, scientific and management;
- Δ technical staff, EHO's and local artisans;
- Δ health and education;
- Δ the community.

Engineering, Scientific and Management Staff

These are those staff who are involved in the design, construction and management of sanitation facilities and systems. These staff need to have adequate training in appropriate engineering, scientific and management topics. Generally this will be done to a level equivalent to a higher national diploma, but more commonly degree or higher degree level.

Higher degrees in public health or sanitary engineering and public health science should be strengthened and where non-existent established within developing countries as few such courses are currently available. Most senior professional staff on large sanitation programmes will benefit from having a higher degree where study is much more intensive and specialised than first degree subjects. In particular subjects such as contract management and legal enforcement issues in sanitation provision should be covered in these courses. The participants should also be encouraged to focus on low-cost and innovative methods of excreta disposal and treatment. It is through the use of such technologies that the urban poor will have access to adequate sanitation at a price they can afford.

Staff from professional disciplines should be kept up to date with developments in the sector and regular in-service training events should be held to ensure that staff maintain interest and motivation. These in-service events may well cover aspects of sanitation apart from the strict engineering or scientific fields and may include case studies and accounts of field experience. This should be encouraged and staff given an opportunity to broaden their knowledge and develop their careers by gaining a greater understanding of all the issues in sanitation provision.

Engineers:
Undergraduate engineering courses should have basic public health engineering as a core component and options in more advanced public health engineering to allow greater specialisation for those who wish to pursue this as a career. All undergraduates should have a basic knowledge of the principal methods of excreta and wastewater disposal and a good basic understanding of the health risks associated with poor sanitation. This should include sections on basic epidemiology, basic microbiology and the principal routes of transmission of sanitation related diseases.

Students specialising in public health engineering should study the full range of technologies available for excreta disposal and wastewater treatment

including low-cost technology for low-income groups. They should be encouraged to assess technologies critically in terms of health benefit, potential for community management, social acceptability and identify areas for improvement on existing technologies. It is important to stress the community role in technology selection and the need for all professional staff to be able to discuss sanitation technologies with communities and to recognise the importance of community empowerment.

Engineering students should also study appropriate methods of health promotion through hygiene education in order that they understand the role education plays in sanitation improvement. It is of great importance that engineers understand the role of health education in sanitation promotion and improvement and recognise that technical solutions alone will not be sufficient to provide the health benefit expected from improved sanitation.

Treatment of wastes, process design of treatment plants, management of waste, the potential for re-use of treated waste and the quality of effluents discharged into the environment should also be covered in optional courses. Operation and maintenance requirements of disposal and treatment technologies should be covered and graduates should be aware of the importance of planning and implementing operation and maintenance schedules to the sustainability of sanitation provision.

Scientific:
These staff will normally come from either a chemical or biological background and they too should be aware of the public health risks of poor sanitation and inadequate waste treatment. In particular they should be aware of principles of excreta disposal, wastewater treatment and establishment of adequate effluent and solid waste quality standards. This should cover not only domestic wastes but also industrial discharges. Scientists may also be involved in technology assessment, particularly treatment technologies as these commonly employ chemical or biological processes.

As scientific are likely to conduct routine monitoring of effluent and waste quality, courses which cover planning of monitoring programmes, sampling techniques and appropriate analytical techniques should be made available to them. Analytical quality control is also vital if the results produced by different laboratories - nationally or internationally - are to be comparable and valid and training should be given to scientists to ensure that appropriate analytical quality guidelines are adhered to in all laboratories. This training may be given through in-service workshops, although the subject should also be addressed during courses of higher or further education.

Management:
Personnel will need training in areas such as personnel management, budget preparation, planning and administration. This is particularly important where technical staff are promoted to management positions on the basis of their technical expertise and find it difficult to deal with management problems.

Management training for technical staff can be given, for instance, through a series of workshops and short (one or two week) courses run by professional managers. Institutions with the capacity to provide this training are often available in African countries, for instance there is an Institute of Public Administration and Management in Freetown, Sierra Leone. Where this capacity does not exist, it's development should be treated as a priority.

Where government and municipal authorities are adopting a more advisory role in sanitation, staff need to be trained in their new responsibilities, in particular in areas such as: contract management; tendering procedures; monitoring of construction; developing strategies for monitoring discharges, effluent and treated waste quality; and legal mechanisms for enforcing compliance with codes of practice and quality standards. If government and municipal authorities move away from construction, staff will also need training in handling and investigating complaints and in resolving disputes between contractors and users.

Technical staff, EHO's and local artisans

Technical staff
These are the field staff who are directly involved in the construction, operation and maintenance of sanitation facilities or in training and supervising local artisans. Generally these will be staff with lower formal education qualifications than those at professional level but who are likely to have extensive practical experience and a thorough knowledge of working with communities or on contracts.

Field staff involved in construction should be aware of basic construction principles and techniques and

be competent in building the required structures and in their operation and maintenance. This requires that staff be given some formal training prior to starting work preferably in a technical college or institute with trained and experienced teachers. This training can be further supplemented by 'on-the-job' training, for instance during an initial probationary period. In the past, however, too much emphasis has been placed on training on the job and too little on a good formal technical training. Staff who only receive on the job training are frequently less skilled than formally trained staff and often develop habits or techniques which adversely affect the standard of construction.

It is recommended that countries further develop existing technical training institutes locally and develop such institutes where these are not exist to improve the quality of technical staff available. These institutes should be decentralised and spread throughout the country, where this is possible, to provide adequate training facilities to all areas. Courses should be designed to be the equivalent of a national diploma or certificate with an emphasis on the development of practical skills combined with some foundation in the concepts of construction engineering.

Most of the skills necessary for sanitation facility construction can be gained in a general building course. Technical staff will need to be able to make concrete mixes of varying strengths, cast concrete structures like pipes, join plastic and metal pipework and be able to build structures using bricks, blocks and timber. For those technical staff who work on a sanitation programme or wish to in the future, options should be available in sanitation construction techniques which should cover the principal technologies used in sanitation improvement and particularly focus on low-cost technologies which are appropriate for low-income areas. Operation and maintenance of requirements for sanitation and wastewater treatment technologies should also be covered.

Technical institutes should also offer courses in basic health education for technical staff which should cover the principal diseases related to poor sanitation, the main transmission routes of sanitation related diseases and the barriers to disease transmission. Construction staff should have a reasonably good idea about the health benefits provided by improved sanitation and can, sometimes, make good health educators. Courses in education techniques for hygiene education should be offered to increase the capacity of technical staff to promote sanitation improvement.

Training of technical staff, as with all staff, should be seen as an on-going process with in-service training events and refresher courses held in construction techniques, technical training and health promotion. Staff who do not have any formal technical qualifications should be allowed and encouraged to gain these through courses at technical institutes. This could be through provision of a leave of absence by the employer to complete a course, or in the students own time.

An alternative strategy is for technical colleges to run courses which can be taken on a modular basis, where students attend a series of short modules of a few weeks or months spread over a prolonged period of time, for instance several years. In between attending modules at the college the students can be set projects which relate to the work they are involved in and which have to be completed within a given period of time. This system has the advantage that staff are not absent from work for more than short periods of time which can be arranged to coincide with slack periods in construction, for instance in the rainy season. Also the member of staff attending the course does not lose income whilst studying, feels motivated because of the opportunity for study and maintains existing skills whilst learning new ones.

Technical staff who will be responsible for training local artisans in sanitation facility construction or operation and maintenance will need training in education techniques. It is not sufficient that they have good skills themselves as they need to be able to pass on their knowledge in a form which is readily understood. These skills should be taught in specific workshops with appropriate staff trained in educational techniques and in particular encourage participative learning and teaching.

Where staff will be involved in monitoring the performance of local contractors they should be given training in how to conduct and plan monitoring activities and how the data generated should be used to ensure compliance. In particular staff will need to develop skills which promote improvement through positive action on behalf of the local contractor rather than threats of punitive action.

Environmental health officers:
The training of staff who can undertake a wide ranging role within the community should be

considered as a high priority. Women should be encouraged to enrol onto such courses and be encouraged to learn technical skills as well as education techniques. The promotion of more positive roles for women than are normally encountered in urban sanitation programmes would be beneficial in most African countries.

Courses for individuals studying to become environmental health officers should be strengthened or established in technical institutions, particularly those which also have courses in community health in community health education or links with institutions that do run such courses. These students require a good basic technical education and should be able to perform many the tasks that specialised construction staff can. This will include elements such as simple slab casting, basic plumbing, joinery, simple design work and brick/block laying. Women should be encouraged to attend such courses and develop technical as well as educational skills.

Environmental health officer training should also contain a strong component of study of hygiene, health and education techniques. Environmental health officers require a thorough understanding of the health risks associated with poor sanitation and how these may be overcome. They may not be able to fill entirely a specialist health educator but should be capable of performing most of the tasks of a health educators role. Thus these students will need to be able to use appropriate education materials and techniques, understand how disease is spread and to barriers to disease transmission and basic epidemiology.

Local artisans:
In many sanitation programmes, particularly those constructing low-cost technologies for community based management, much of the building work is done by trained local artisans who reside in the community. The use of local masons and builders can be important for the long-term sustainability of urban sanitation and also the replicability of pilot urban sanitation programmes more widely.

Where private contractors are used to construct sanitation facilities they will require training in design, appropriate construction techniques, quality control and tendering procedures. This should be offered by appropriate local educational institutions who have a good understanding of the process of approving designs, monitoring construction progress and quality and assessing tenders.

Local masons and builders may need additional training in order to be able to construct sanitation facilities to the required standard. These skills can be passed on during workshops which should cover areas such as quantity estimation for latrine slab construction, casting reinforced slabs and pour-flush pans and the installation of vent pipes. Before a local artisan is registered as an approved builder of sanitation facilities, municipal staff should be confident that they have reached a sufficiently high technical standard that will ensure that all sanitation facilities constructed meet municipal construction quality standards.

Where codes of practice for construction are established local artisans should be made aware of them and training made available to ensure that they can fulfil these requirements. If artisans are to submit tenders to municipal authorities for sanitation facility construction, training should be given to ensure that they understand the process of submitting a tender and the management of a contract.

Where pit latrines and septic tanks require emptying, local contractors may fulfil all or part of this role, as is the case in Dar es Salaam, Tanzania. If this is done, then the contractors may require training in the use and maintenance of equipment, safe disposal of waste to protect public and environmental health and should be aware of health and safety practices to safeguard their staff's health. This last point is vital as poor handling of wastes during removal and transport can lead to a serious risk to the health of workers and households whose pits are emptied.

Wherever local artisans are used, the municipal authority will need to monitor their performance and retain the right to revoke licences to operate if there is a persistent failure to comply with construction quality guidelines, codes of practice and safety standards. Nevertheless, the municipal authority should seek to establish a positive relationship through training and monitoring, rather than rely on censure of failures as a means to pursue adequate quality.

Health and Education Staff

There are numerous personnel with different skills who may be involved in health education and hygiene promotion: environmental health officers; nurses in clinics and community health programmes; health inspectors; community development workers; teachers; and specifically-trained health education staff attached to sanitation programmes.

In some countries the roles of different sectors may overlap, thus community development workers may be assigned to environmental health education programmes as happens in Ghana. In other countries staff may be specifically recruited and trained for community health education. In addition to staff working directly with sanitation provision programmes there are professionals such as school teachers and medical staff who also have an important role to play in health education.

The training needs of each group are slightly different but it is important that all those involved in health education relating to sanitation provision should provide similar and compatible messages about health. It is likely to be more damaging to have a series of people giving communities different and contradictory advice than to have no health education at all.

Health Education Field Staff

These are those staff who are working with a sanitation programme or on a complimentary programme to sanitation provision. They may be professionals with qualifications gained from institutions in-country or overseas or locally-recruited staff who work in their own community. Although the level of training may vary, all staff should have some training in germ theory, routes of disease transmission, disease prevention through environmental health and participative education techniques.

Staff should be collectively able to reach all sectors of the community with their health messages and should be able to act as a catalyst for discussion and change within the community. Health education programmes where the community is actively involved in the education process are likely to have a greater impact than those where messages are delivered to a passive audience. Health education staff should be able to develop and use appropriate education methods such as drama, songs and focussed group discussion and materials such as flip charts in order to involve the community in the education process.

The training of health education field staff can be achieved in a number of ways, with a mixture of formal and 'on the job' training. However, as with technical staff, in many instances too much emphasis in the past has been placed on informal training with limited formal education given. This can result in field staff not fully understanding education techniques and not having a thorough grasp of the transmission routes of disease and the barriers to transmission. It is important that all staff receive some form of training away from their work station in order that they may concentrate fully on the subject matter.

Institutions offering degrees or qualifications equivalent to higher national diplomas (HNDs) should be encouraged to provide courses in community health education and development. Courses with similar themes, for instance community development or primary health, may already be available and where this is the case, institutions should be encouraged to provide a specific option in community health education. These courses should cover education techniques, educational material development, disease transmission, germ theory. At degree level there should also be a strong component of theoretical concepts and the planning of health education programmes. HNDs should have a strong practical component and emphasis placed on implementation of community health programmes. In both cases case studies using on-going or recent health education programmes should be used. These should cover both successful and unsuccessful programmes so that students understand how and why health education programmes achieve success and why they sometimes fail.

It is beneficial students of both degree and HND health education courses that public health interventions are covered. This is important as community health education staff have to understand what technologies can assist in the prevention of disease, which are the most appropriate for particular circumstances and be able to convey the advantages, disadvantages, cost and operation and maintenance requirements for technology to communities. Where sanitation programmes are set up, communities - particularly in low-income areas - may have little idea of what technology is suitable and thus if offered a choice may find it difficult to select the best option. The health education staff can help community members to decide what type of sanitary facility they require in terms of health benefit, operation and maintenance requirements and cost.

Students should also be taught how to evaluate the sanitary conditions of communities through the use of techniques such as sanitary inspections and interviews. Students should be taught how to use the data generated to improve the focus of education. Many of students from this level of education may be involved in community health worker training and should receive some training for trainers.

All health education staff will benefit from regular in-service training events and workshops once they start working for a programme. These should be designed to keep staff up to date with the latest developments within the health education field, teaching materials and to exchange experience. Workshops should be short and focussed on one topic, for instance education material development and use, and be directly relevant to the work that the staff are involved in. This will help to keep staff motivated and will help to ensure that the quality of education given is good.

Other Professionals

All the above refer to staff who receive training specifically in community health education and community development and who work as health educators on sanitation programmes. However, there are other professionals who may also be involved in health education. Nurses and teachers are two such groups which are frequently involved in some community education, although often covering a wider range of topics.

During training, nurses should have options in health education available to them, in particular focussing on appropriate participatory education techniques. One criticism sometimes made about medical personnel involved in health education is that they give very short talks during clinic sessions. These are generally not participatory, but lectures to groups of, often, mothers with young children. Obviously staff at clinic sessions have many demands on their time and cannot realistically be expected to concentrate solely on hygiene education. However, the importance of good basic hygiene to health should be stressed. Nurses who are involved in community outreach projects should use these as a forum to discuss sanitation and the associated health risks with community members.

The medical profession frequently does not see sanitation as its responsibility. However, given the high incidence of diseases affecting the populations of developing countries which may be linked to poor sanitation and poor water supply there is an important role for the medical profession in sanitation. Doctors may be encouraged to study other branches of health intervention, for instance the University of Nairobi offers an MSc for doctors in Public Health Engineering. This may help the health sector to provide a greater input into technology selection and help focus health sector research priorities.

School teachers can also be effective health educators and hygiene education should be incorporated into the school curricula. The advantage of teaching children to adopt good hygiene practices is that once it is accepted as normal behaviour it is likely to remain with them for life. Children who receive health education can also be effective health promoters within the home and between each other. 'Child-to-Child' health education programme where children pass on health messages through story telling to younger children have been successfully implemented in a number of countries, particularly in Latin America. Children can also persuade adults to adopt good hygiene practices, as well as their own families once they reach adulthood.

Teachers should receive courses on health education during college courses and later through in-service workshops. This should cover aspects such as germ theory, barriers to disease transmission, good hygiene practices and their effect on health.

Community Education

Particularly in low-income areas where the educational level of the population is often low and there is very restricted access to services there is a need for on-going education. Community education should also be a means to improve womens quality of life and to empower them to take greater control over their life.

Community health education should be participative and should build on local knowledge and perceptions as much as possible. Communities should be active participants in the education process and work with trained staff to identify their training needs and how this training should be implemented. If communities are not consulted and made part of the planning and implementation process the risk of resistance to education programmes is likely to be higher and implementation less successful.

Prior to the start of any sanitation programme a thorough knowledge, attitudes and practice (KAP) survey of community sanitation should be done. Communities should be sensitised toward sanitation and the health risks associated with sanitation discussed with them. This will enable the community and health education staff to plan the education programme and how it should be implemented.

Community education should be well focussed and respond to the real needs of the community and not designed to fit into the programme planners' perception of what is needed. Communities often

have a good understanding of their health problems but may lack resources or ideas about solving these problems. Communities are often not aware of how much they can do themselves to improve environmental and public health conditions and often what is most required from education programmes is empower the communities to solve their own problems and become more self-reliant.

In many communities there may be a need for basic hygiene education to ensure that people use latrines, keep them clean and wash their hands after defecation and before eating. In particular training may be required to ensure that children's faeces are properly disposed of. There is a common misconception throughout the world that children's faeces are harmless. This is not the case and the improper disposal of children's faeces represents at least the same health risk as that of adult's faeces.

Where latrines are introduced parents are often unwilling for their children to use it as children may be frightened by the dark, frightened of falling into the pit or of snakes or wild animals being in the superstructure. If this is a common fear, parents should encourage their child to defecate into a pan or in one particular area, with the faeces thrown down the latrine immediately and both parent and child washing their hands. Parents should encourage their children to use a latrine as soon as possible and this should be further encouraged at schools and community centres.

Community training may be provided through workshops for community groups, discussions with all sections of the community and through house visits to meet the occupants and discuss health issues with them. Where educational aids such as flip charts and dramas are to be used in community education these should be thoroughly pre-tested to ensure that the message they are intended to convey is understood by the recipient audience. It is also important that any materials or educational methods used are culturally and socially acceptable to the target audience. If the education breaks cultural taboos or deals with culturally sensitive matters with a lack of respect then the community may become quickly alienated and resist further educational activities. Thus, materials and techniques which have been successful in one area should not be directly transferred to another area without first checking that it is acceptable and understood. If pre-testing shows that changes need to made these should be done before any mass education programme is attempted.

It is often beneficial to identify those members of the community who are interested in health and have a good understanding of the needs for good sanitation. These people can be taught community health education and become community health workers whose role is to provide a continuous presence of the health education team. Community health education is a role that is commonly filled by women as much of the focus of hygiene education programmes is on women and children. Women can be very successful health educators particularly in their own community where they are known. However, this should not be seen as the only role that women can adopt but only part of their wider responsibilities within the programme.

The use of community health educators has been successfully implemented on a number of projects and notably on the KWAHO project in the Kibera area of Nairobi, Kenya. Here the majority of the health education is done through voluntary health promoters who reside in the community and work with the community to improve health. Workshops are organised using the local community health workers to give health education talks, community health workers help the community management committees to allocate times for pit latrine desludging and organise clean up days to remove solid waste and burn it.

Community health promoters should be given some formal training out of their community, possibly through a series of short workshops. This often helps to motivate community workers, who are often volunteers, and allows them to give their full concentration to the subject in a way which may not be possible in their community. Additional training can be given on the job by ensuring that health workers are attached to trained staff for a period of time.

Community health workers and other members of the community can also benefit from visits arranged to other areas to look at sanitation programmes and discuss with other communities common problems and solutions. This often helps to give the community fresh motivation to keep up health promotion and also helps to focus their attention on sanitation conditions and health problems. It also encourages them not to feel isolated and to realise that other communities also face similar problems and that solutions can be found.

Infrastructure

Introduction

The physical infrastructure of urban sanitation systems should facilitate the isolation, containment and/or removal and inactivation/treatment of excreta and domestic wastewater. From a public health engineering point of view it is important that all stages of sanitation from initial isolation from the user onward are adequately designed for at the planning stage. Such a 'holistic' approach helps to avoid problems in the future and for communities not covered by urban sanitation programmes.

Many cities in the developing world at present either have no facilities for disposal and treatment of wastewater and excreta for the majority of the population or have inadequate capacity for disposal and treatment. This has led to the disposal of excreta and wastewater into storm drains which become open sewers with a significant health risk to the population. Much of the 'sewage' generated is allowed to flow into receiving waters untreated. This has led to gross contamination of rivers downstream of cities with the attendant health risks to communities using river water for drinking purposes and to fish and other aquatic life.

It is important that due consideration is given to domestic non-toilet wastewater, or 'sullage', disposal in the planning stage of any urban sanitation upgrading programme. Where sullage is not disposed of properly it can cause significant health risks to the population if standing pools form which provide breeding sites for mosquitoes and flies.

As these insects are vectors not only for faecal-oral disease but also diseases such as malaria and Bancroftian filiariasis, potential breeding sites should be eliminated. It has been noted that in the poorer sections of a number of cities in India that filiariasis is becoming an increasing problem due to poor latrine design and poor drainage which encourage the breeding of the *Culex pipiens* mosquito, the common vector of filiariasis.

There is a wide range of technologies available for safe, adequate excreta disposal and sullage removal which offer differing levels of service and user comfort. In order for sanitation to be sustainable, realistic charges will have to be levied on users of community sanitation systems such as sewerage, to cover operating and maintenance costs, including wages. In some circumstances, it may also be appropriate to recover some of the capital investment costs. Thus, it is unlikely in urban areas in developing countries that one technology can be applied on city-wide basis as the ability and willingness to pay for services will vary between socio-economic groups. Flexible approaches to sanitation provision and cost recovery will need to be introduced, typically with less sophisticated technology and increased community management of systems in poorer areas, with a correspondingly lower charge structure.

The treatment of excreta and wastewater must be planned for at the start of any sanitation programme with appropriate processes identified and plants built. It is also important that municipal authorities plan for how wastewater and excreta will be taken to the point of treatment, particularly where on-site methods of excreta disposal which require periodic emptying are employed. Codes of practice for cartage of excreta which correspond to adequate health and safety measures are established to protect staff involved in excreta handling and transport. Quality standards for effluent leaving sewage treatment plants into receiving waters should be established and rigorously enforced to protect the environment and the health of those communities which live downstream of a sewage treatment plant.

The introduction of improved sanitation and the type of technology employed should be 'demand - led' and governed by the willingness and ability to pay of communities or individuals for the level of service. Communities should be made aware of the possible technical options in their area, the financial and management requirements for those systems and allowed to choose the type of technology and the level of responsibility for management they are willing to take. This will increase the notion of ownership of sanitary facilities and thus contribute to improving the care taken of the facilities.

Standards should be set for the disposal of industrial effluents/discharges as well as domestic sewage. Government and municipal authorities should decide whether it is acceptable for industrial wastewaters to be disposed of through the sewerage system and

treated in the same plant as domestic sewage and if so what quality the sewage should be prior to discharge into the plant. If industrial sewage is to be treated at source, then standards of effluent quality should be set. There should be legal enforcement of effluent quality standards and compliance with these standards by waste producers. Where standards are introduced or tightened, mechanisms for progressive implementation should be established.

Technology Options for Excreta and Sullage Disposal

The technologies available for urban excreta disposal include:

- on-site methods (where excreta is contained initially on-site but may be removed at a later point);

- sewerage (which transports but does not treat excreta);

- cartage (where excreta is transported to a disposal site).

When assessing the feasibility of different technologies the cost, ease of operation, maintenance requirements, anal cleansing material and level of water service should be considered. The principal technologies are briefly described below. For further design details reference should be made to suitable texts, some of which are listed in Annex 2.

On-site methods

There are numerous types of on-site technologies for the disposal of excreta, some will also provide a suitable means of sullage disposal whilst others require the separation of toilet and household wastewater. These technologies are further sub-divided by high-cost solutions, typically with a high degree of user comfort (for instance septic tanks and aquaprivies) and lower cost technologies which can provide an equal health benefit to the user and a lower level of user convenience, usually some form of improved pit latrine.

Pit latrines

Pit latrines have been a common means for excreta disposal in urban areas for a long time. In most countries there is some tradition of building and using pit latrines for excreta disposal. However, many unimproved traditional latrine designs are unhygienic and represent a significant health risk to the users and, to a lesser extent, the surrounding population. Where latrines are poorly built and maintained they provide breeding sites for flies and produce offensive odours. Thus, in recent times there has been a belief amongst planners and engineers that pit latrines were not appropriate for urban areas and that more sophisticated and expensive systems of excreta disposal were required. However, it has become increasingly apparent that in many situations in urban areas pit latrines can offer a technically, socially and economically feasible improvement of urban sanitation with significant health benefits, particularly to the urban poor who do not have resources to pay for high technology facilities.

Pit latrines are generally the cheapest form of sanitation possible and have often been introduced in the poorer areas of cities. The ease of operation and construction make them most appropriate to introduce into areas where a significant level of community management is required. However, pit latrines do require a reasonable amount of land to be feasible and in urban areas land is often at a premium. Where there is room, when the pit fills a new pit can be dug and the slab moved across onto the new pit.

Where space restrictions limit the possibility of digging a new pit then latrines with two pits may be dug. If this system is used only one pit is actually in use at any time. When contents reach within 0.5m of the top of the pit, it is sealed and the empty pit is put into use. The full pit is later emptied and if left for a minimum of two years, the contents can be dug out manually and used as soil conditioner or if it has been composted with other organic material it can be used as a fertiliser. Where pits are small, or there is only room for one pit it is also possible to empty pits more frequently using mechanical equipment. The types of equipment required for pit emptying are discussed later in this section.

Where there is a high water table pit latrines can be raised to provide additional pit volume. However, there should always be a minimum of one metre between the bottom of the pit and the wet season water table to prevent contamination of groundwater. Under these conditions sealed pits may also be used, but the extra cost may make other technical options more attractive.

There are a number of improved latrine types. All work on in a similar fashion with the pit used for the isolation of excreta from human contact and the

liquid part of the waste in the pit infiltrates into the soil through the sides of the pit or in an adjacent soakaway.

Improved traditional designs - these include examples like the 'sanplat' latrine widely deployed in Mozambique and increasingly in other countries. Generally these improved latrines incorporate a concrete foundation and a hygienic, concrete slab which may or may not be reinforced. The 'sanplat' design utilises a domed slab which requires no reinforcement because it's shape provides sufficient structural strength. This represents a considerable cost reduction in comparison with reinforced slab designs.

Improved traditional designs of latrine are rarely ventilated and thus potential problems with smell and flies remain. These problems can be partially overcome by the use of a 'stopper' which fits the squat/pedestal hole and is kept in place whilst the latrine is not in use. However there will always be some access to flies whilst the stopper is off the hole and some odour problems. Where people commonly wash in the toilet area the use of improved traditional latrines may be problematic as this may decrease the life of the pit, possibly affect the rate of solids digestion and have a limited impact on fly or odour reduction. However, in many low-income areas the introduction of an improved latrine based on traditional designs and at low cost may well be an appropriate solution with a significant health benefit.

Ventilated Improved designs - these are latrines which have a vent pipe to remove odours and which have a fly-proof mesh on top of the pipe, which can greatly reduce the numbers of flies breeding in the pit. These latrines can be more hygienic and pleasant than traditional designs when properly maintained. However, there are disadvantages in their use in urban areas, in particular correct siting may be difficult. In order that the mechanism for odour control will work properly, there needs to be clear flow of air across the top of the vent pipe, thus the latrine should be in an area where there are no buildings higher than the top of the pipe in the immediate vicinity..

Pour-flush latrines - these latrines have a water-seal set in the slab or pedestal to prevent odour and fly breeding and usually require a minimum of 1-3 litres per flush. Pour-flush latrines can be constructed with an offset pit or one directly beneath the slab and the liquid waste either infiltrating through the sides and base of the pit or in a soakaway adjacent to the pit. The squat slab or pedestal may be located indoors or outside. These latrines are particularly appropriate where water is used for anal cleansing as users are already used to carrying water when going to defecate. They are more expensive than other types of latrine but can provide a high level of service to the users, isolate excreta from human contact and can be easily connected to sewers at a later date if required.

Septic Tanks

These are a more high cost on-site sanitation technology which gives the users the benefits of conventional sewerage with flush toilets and can also dispose of domestic sullage. The tank is offset from the house and connected to the toilet and other domestic wastewater by a short drain. The tank holds the solids and an adjacent soakaway is used to dispose of the effluent. Septic tanks require a reasonable amount of land for constructing the tank and soakaway and require periodic emptying, usually every few years. This must be done safely as septic tanks contain fresh excreta which represents a significant health risk. Emptying is commonly done by vacuum tanker with the contents taken to a treatment sewage plant. Septic tanks can be easily connected to sewers if required and are commonly found in large houses occupied by the wealthier groups in the city.

Aquaprivies

These are similar to a septic tank and can be connected to flush toilets and take most of the household sullage. Aquaprivies consist of a large tank with a water seal formed by a simple downpipe into the tank to prevent odour or fly problems. However, unlike the septic tank the chamber of the aquaprivy is right beneath the toilet and not off-set but like septic tanks require periodic emptying. The tank is connected to a drain field or soakaway to dispose of the effluent. Water must be added each day to maintain the water seal and there are frequently problems with keeping the seal intact, which leads to odour and fly problems. Aquaprivies are expensive, require relatively large areas of land and offer no real advantages over pour-flush latrines. They are likely only be used in higher income areas within cities.

On-site sullage disposal

Even with low levels of water service (for instance communal tapstand) most families generate a considerable amount of sullage per day. As a rough guide, a household which collects water from a street tapstand will generate about 25-30 litres of sullage

per capita per day minus any water used for anal cleansing or toilet flushing. In many urban communities the provision for sullage disposal is poor or non-existent. In areas that are served by sewers, septic tanks or aquaprivies sullage can be disposed off with toilet wastes. Where pit latrines are used it is not advisable to throw sullage into the pit. In lower density areas a soakaway can be constructed if the soil is sufficiently permeable or where sullage is used to irrigate household gardens.

In many areas the soil is not sufficiently permeable to allow the infiltration of the volumes of water generated and in high density areas it may difficult to find room for a soakaway, thus sullage is often either just thrown out into the street or into storm drains. Neither is a hygienic method of sullage disposal. Sullage still contains faecal contamination (although at low levels in comparison with sewage) and organic matter. As storm drains are designed for far greater flows there are likely to be blockages which will cause the ponding of sullage and thus encourage the breeding of mosquitoes and flies with the attendant health risk. Where water is thrown into the street or yard it is likely that standing pools will form. Wherever possible sullage should be disposed of into a covered drain or a soak pit to protect the user's health.

Sewerage

Conventional Sewerage: Water-borne disposal of excreta and (sometimes) other household wastewater through conventional sewerage is often considered the most suitable means of providing urban areas with adequate sanitary facilities. Whilst the level of service offered by the use of conventional sewerage and the convenience provided for the user is high, it is expensive and generally beyond the means of poor people to pay for. Thus unless the municipal or national authorities have sufficient resources to subsidise the construction, operation and maintenance of sewerage in a city it is unlikely to serve more than a minority of the inhabitants.

Conventional sewers carry all household wastewater and solids through a series of pipes direct to a treatment plant. Large diameter (minimum 225mm) pipes of concrete, asbestos cement, clay or PVC are laid at relatively steep minimum gradients to ensure a minimum velocity required to keep solids in constant suspension is met, usually between 0.6 to 1 metre per second. Where bulky anal cleansing material is used or sand is used for scouring kitchen utensils , velocities of not less than 1 metre per second are required to prevent blockage of the sewer. To achieve the required gradients, sewers commonly have to be laid quite deeply and expensive pumping stations required to lift sewage to higher elevations.

Sewers require periodic cleaning and inspection and to facilitate this inspection hatches must be provided along the line of the sewer for access. Where conventional sewerage is used it is unlikely that the community served can undertake the maintenance work and thus staff must be employed to undertake these tasks.

Shallow sewerage: This is a form of modified sewerage which provides the health benefits and convenience of conventional sewerage to the user but at reduced cost. Shallow sewers, as the name suggests, are laid at shallower depths than conventional sewerage, generally use pipes of a smaller diameter and are laid at shallower gradients all of which reduces the cost of sewer installation. Sewers are laid along the sides of roads and alleyways to protect the pipes from damage from vehicles and as a result PVC pipes can often be used instead of concrete. Inspection holes are also shallower which again reduces cost.

Unlike conventional sewerage where solids are kept in suspension continuously shallow sewerage works on the principal that if a blockage occurs, water will build up behind the obstruction and reach a point where the pressure is sufficient to re-suspend the solid particles. Thus solids move down the sewer in a series of movements rather than a continuous flow as in conventional sewers. As there is no need to keep solids in constant suspension, the water requirement to keep shallow sewers functioning correctly is reduced. The laterals to each household are kept as short as possible and within a short distance of the house join laterals serving a block. As the flow through the block lateral will be relatively high, there is rarely a problem in ensuring that sufficient water is available to resuspend solids.

There is far greater potential for community management of shallow sewerage in comparison with conventional sewers as cleaning and inspection is much simpler and as the sewers are shallower there is less risk to inspectors. Community management of shallow sewerage systems has been successfully implemented in the Orangi Pilot Project in Lahore, Pakistan.

Small-bore sewerage: This is another form of modified sewerage which uses an interceptor tank on

household or lane plots to contain solids and small diameter pipes to remove effluent. As smaller pipes are required the cost of the sewers is reduced and as only liquid flows through the sewers they can be laid at flat gradients with fewer inspection holes. The interceptor tanks need regular desludging and this can increase the cost considerably.

Small bore sewerage can be effective. However, in a number of instances there have been problems with overflow of solids from the interceptor tank into the pipes which can cause blockages. This may be due to several reasons, but frequently there is a problem of under-design of tanks so that if emptying is not done at the correct time there is little or no extra capacity. Another common problem is that if large volumes of water periodically flush through an interceptor tank which is small, the force can be sufficient to carry some solids into the pipe. These problems can be overcome through proper design, operation and maintenance.

As with shallow sewerage there is greater potential for community management of small-bore sewers than conventional sewerage. Little inspection work of the pipes is required as they essentially only carry liquid and, if the interceptor tank is well designed and regularly emptied, the risk of blockages is low. Community emptying of the interceptor tanks may not be possible.

Cartage

Direct cartage: This involves the removal of fresh excreta to an off-site disposal point. Cartage is practised in urban areas in many parts of the developing world, most frequently through the use of bucket or pan latrines. These are latrines where a bucket is kept under a seat in the privy which is emptied by hand on a regular basis (usually every 2-3 days) and transported to a dumping site in a handcart or some other means. This is extremely hazardous to health, for the people who collect the waste and, to a lesser extent, the users of the latrine and the general public as raw excreta may be spilt in streets as the buckets are emptied. Commonly it is also found that the excreta is not treated after collection but merely dumped at the nearest convenient point, such as waste ground or storm drains. This represents a major health hazard.

Mechanical cartage: cartage can also be operated by using vault latrines which completely isolate the excreta from human contact and which are regularly desludged, usually using mechanical equipment. This is expensive and may still represent some health risk particularly to the emptier.

In some other circumstances cartage is also required, usually where on-site methods of excreta disposal are operated such as septic tanks and single pit latrines. Provided this work is done either by professionals with adequate training in appropriate health and safety practices and protective clothing, this can be operated safely.

Desludging equipment: this commonly works by the removal of waste by suction provided by a vacuum tank which may be manually or mechanically powered. Mechanically powered desludging equipment is more prone to breakdown because of the heavy wear it receives and as this equipment is commonly made in developed countries, there is therefore a foreign exchange requirement to purchase parts. It is also often difficult to service all areas of the city - particularly poor and congested areas - as access for vehicles may be problematical. This can be overcome using smaller body designs or systems where the vacuum tank can be removed from the body of the vehicle. However, mechanical equipment does have a far greater capacity for sludge removal than manual methods and where users can afford the service and are accessible may be appropriate.

Manually operated desludging equipment works on the same principal as mechanical desludgers but the power to apply suction is provided by hand. These technologies are often appropriate in low-income and inaccessible areas of cities where large trucks may not be able to reach and have been widely used in Dar es Salaam and in Abidjan. There is considerable potential for private sector involvement in manual and mechanical desludging.

Technology Options for Wastewater Treatment

It is important that wastewater and excreta are adequately treated before discharge into the environment. Pit latrines which contain excreta for at least two years perform the process of breakdown and inactivation of pathogens on-site. Thus in some areas pit latrine contents are dug out safely by hand after two years and applied as a soil conditioner for agriculture. This process can be improved by adding additional organic material to the pit during it's use to produce a compost which can be used to fertilise crops. The products of other forms of excreta and wastewater disposal, such as sewers, septic tanks or

pit latrines that are emptied more regularly than every two years require treatment as these contain raw excreta and represent a significant health risk.

There are a number of ways of treating wastewater and solid waste: disposal of solids in landfill; treatment of solid and liquid waste in waste stabilisation ponds (WSPs); treatment of liquid and solid using conventional sewage treatment technologies such as biofilters.

Conventional sewage treatment technology: this will significantly increase the cost of treatment. Most plants use complex technology which require skilled personnel to operate and maintain the plant. The chemicals and spare parts required by the plants may not be available have to be imported which implies a foreign exchange requirement. The effluent leaving conventional treatment works may be improved in terms of biological oxygen demand (BOD) and suspended solids (SS) content, but still represent a significant health risk due the presence of microbiological pathogens.

Waste stabilisation ponds: these are a series of ponds into which the liquid and solid waste flows and is retained for sufficient time for the solid content to settle out, for the biological load to be reduced and for pathogens to die off. There are much cheaper to operate and maintain than conventional sewage treatment works, employ low technology and require little or no mechanical equipment. They do however, require a substantial amount of land which has often been used as an argument for not using waste stabilisation ponds for urban wastewater treatment. However, the lower long term costs and the potential income from the reuse of treated waste may outweigh the initial land costs. Also waste stabilisation ponds do produce effluent of high quality particularly with regard to microbiological criteria. Figures as low as 30 faecal coliforms per 100ml and BOD of 17 mg/l have been obtained from pond series in Brasil. These figures are better than those commonly associated with conventional sewage treatment plants.

In a typical pond series, waste flows initially into an anaerobic pond where the majority of the solids are deposited on the floor of the pond. Septic tank and pit latrine wastes may also be dumped in the anaerobic pond. The solid waste decomposes under anaerobic conditions at the bottom of the pond and many of the pathogens settle out with the sedimented solids. Following the anaerobic pond the liquid waste flows through, usually, a facultative pond and then one or more maturation ponds. The facultative pond may still contain some solids and operates on a partially aerated regime with aerobic conditions found near the surface of the pond and anaerobic conditions at the bottom. The maturation ponds are completely aerobic and develop an algal bloom which kills off most harmful bacteria left in the wastewater.

The effluent from the final pond is discharged into the receiving waters or may be used for irrigation water or for aquaculture. If the effluent is to be reused it should meet the following quality guidelines:

For unrestricted irrigation (edible crops, sports fields and public parks)	1 viable nematode egg per litre	0 FC/ 100ml
Restricted irrigation (trees, industrial crops, fodder crops and pasture)	<1 viable nematode per litre	<1000 FC/100ml

For further details of wastewater reuse and waste stabilisation ponds, refer to the publications list in Annex 2.

Technology Choice

Technology selection is a vital stage in urban sanitation provision as inappropriate technologies are likely to result in slow uptake, poor maintenance and rapid breakdown. The technology selected needs to: satisfy the users needs; be affordable; provide a recognisable health benefit; and be technically feasible in the area where its use is proposed. All these issues must be addressed when deciding which technologies are appropriate for urban areas and under what conditions each is suitable. It is unlikely that a single technology can satisfy the entire urban population's needs and municipal authorities should be flexible in their approach to technology selection and how the technology will be delivered. An outline scheme for the decision making process of technology selection is summarised in Annex 3.

Technology selection is a vital part of implementation and this must be done sensitively and be demand-led. This means that it should be the users who select the technology they want for their household. Municipal authorities should have information available which will help communities decide what technology they require, which may include negative information about inappropriate

technologies.

When assessing which technologies are potentially suitable for use in urban areas the health benefit provided by each should be evaluated and those which do not give a significant health benefit should be rejected. Of key importance for health benefit assessment is whether a technology will isolate fresh excreta from human contact except under controlled conditions with trained staff using adequate safety equipment.

An initial evaluation of this type will commonly eliminate most forms of direct cartage, in particular the use of bucket latrines as these pose a significant health risk. Where some form of cartage is required, for instance in emptying pit latrines or septic tanks, the risk to the people employed for this should be assessed at the start and if implemented clear codes of practice which correspond to adequate health and safety protection established and thorough training given in this use of equipment.

Having selected a range of technologies which will provide a health benefit the municipal authority should critically assess under what conditions each technology may be appropriate, in order that the community can assess the most suitable technology to the meet their needs and desires. This assessment will involve consideration of a number of factors: technical (including housing density and type, geological conditions, levels of water supply service and operational and maintenance requirements); social; and, financial. These factors are related and cannot be viewed in isolation. However, the health benefit afforded by each technology must be of paramount importance. Some of the principal factors affecting technology choice are discussed below.

Housing and land availability

The density of housing, the number of people living in each building, their income level, existing sanitation technologies and issues of ownership all impose constraints on technology choice. Where housing is very dense on-site technologies are unlikely to be suitable and an off-site method of excreta disposal will be required. Where a large number of people live in one building, on-site facilities may have to be shared if this is acceptable or off-site technologies with individual connections used.

In low-income areas the ability and willingness to pay may be such as to necessitate shared facilities. In high-income areas individual connections may be more appropriate as users are more likely to be able and willing to pay for higher levels of convenience. Where houses are owned by a family who reside there, an individual on-site facility or connection to off-site technology may be appropriate. In areas of rented accommodation then shared facilities may be more suitable, depending on the number of people living in the building, their income and relative costs of different options.

On-site technologies including pit latrines, septic tanks and aquaprivies will require an adequate amount of open space for: a reasonable set-back distance from the house for latrines (3-6m); to dig pits and construct tanks; provide drain fields or soakaways for wastewater; and, if pits are to be emptied then reasonable access for desludging equipment.

Of particular importance will be available space for disposal of sullage and infiltration of effluent. In Kumasi, Ghana, it was calculated that $1m^2$ of drain field was required for every 15-25 litres per day of liquid waste. Thus, for a building which houses 20 people who use 30 litres per day, all essentially sullage, will require a minimum of $24m^2$ for sullage disposal (using a maximum figure of $1m^2$ per 25 litres/per capita/ per day).

Sewerage has little spatial constraint, but require a high level of water service, suitable plumbing and access for connections to lateral and mainline sewers with space for inspection holes.

Geological Conditions

The key geological constraints on technology suitability are: dirty water infiltration rate; soil and rock type; depth to the water table; and, depth to the impermeable layer. Dirty infiltration rate is important as this is likely to be lower than the rate for clean water infiltration as sullage and liquid wastes contain solid, organic and biological loads which can block pores and obstruct seepage. It is important to assess saturated soil infiltration rates as drain fields and soakaways will function at least part of the time under these conditions. Pit latrines where liquid wastes infiltrate into the soil will function under these conditions at their base and sides as the pit fills.

It is important to be sure that soakaways, drain fields and pit latrines will still function and remove liquid during periods of heavy rain as well as in dry periods. The infiltration rate needs to be sufficient to remove the required volume of water each day but low enough to allow proper filtration through the soil and

rock to remove solids, bacteria and organics.

The depth to water table is important as sullage and pit latrine liquid waste needs several meters of unsaturated soil to percolate through to remove pathogens. This depth varies with soil type with fine soils like silt and clay requiring a smaller distance then coarse soils like sand or loams. Where the impermeable layer is close to the ground surface there is likely to be a shallow water table and thus a greater risk of contamination of groundwater from liquid wastes.

Soil type and underlying geology will dictate the rate of infiltration and whether there is risk of contaminating groundwater. Where soils are very permeable and the water table is high there is a significant risk of groundwater contamination which has implications for its suitability for drinking water. The contamination can be from bacteria and pathogens or from excessive nitrate build up, both of which have implications for human health if the aquifer is used for drinking water supply. This risk is particularly high in urban areas where pit latrines and on-site sullage disposal is practised as the concentration of the biological load is high and the survival rate of bacteria in groundwater increased as the nutrient load is raised. The same may also true of nitrate build up in urban groundwaters.

In areas of very permeable soil and rock, particularly where there are also high water tables, the use of on-site methods of sullage disposal and latrines using percolation of liquid wastes may not be appropriate. Under these conditions either on-site technologies which store liquid wastes and possibly sullage in a water-tight pit which is regularly emptied may be most appropriate. Alternatively, toilet wastes may be stored in a water-tight pit and emptied and sullage (which carries a lower biological load) disposed of on-site or in covered surface drains. Sewerage may also be an appropriate method of wastewater disposal under these conditions.

Level of water supply service

All water-borne methods of sanitation require a volume of water to be flushed down the system each time they are used. Conventional sewerage requires a minimum water consumption of 65 l/c/d to ensure a sufficient flow through the sewers. Other forms of sewerage have been implemented with water consumption as low as 27 l/c/d, largely made possible modified design criteria. On-site methods may require a high level of water consumption and service, for instance septic tanks, or a very low consumption as is the case with latrines.

Generally, where there is a water service to the house then either some form of sewerage or a septic tank is likely to be most appropriate. Where water is supplied at a yard level of service then modified sewerage or pour-flush latrines may be used and where water is supplied at communal points, for instance a tapstand in a street, then some form of pit latrine is likely to be the most appropriate option. If people have a low daily water consumption and have to collect their water from some distance, it is unlikely that they will collect sufficient water to flush toilets. This represents a significant health risk and an appropriate method of excreta disposal selected which takes this into account.

Operation and maintenance

The level of operation and maintenance required and who is responsible are key issues in sanitation provision. In general, in low income urban communities the users of the facility should be responsible for the operation and maintenance of the individual sanitation facility they have access to. This means that where on-site methods are used the user will be responsible for all operation and maintenance, apart from emptying.

Sewerage systems are more complex, although the user will be responsible for the connection in the house; responsibility for maintaining sewer systems may be less clearly defined and a variety of situations can occur. In some areas, for instance in poor areas of Lahore, Pakistan, community management of modified sewerage has been successfully implemented and most of the routine inspection work is undertaken by community members. In other areas, in particular higher income areas, operation and maintenance is the responsibility of the sewerage company who levy a charge on the users in order to cover costs. Generally the more complex maintenance becomes, the lower the potential for community involvement and the greater the cost to the user.

Cost

Both initial capital and recurrent operation and maintenance costs exert a strong influence on technology choice. Water-borne systems are usually more expensive per capita than on-site systems as they involve the laying of pipes and require more extensive operation and maintenance.

The proportion of the cost of installation and operation and maintenance which will be borne by

the user and the level of subsidy (if any) offered by the municipal authority or government will influence the technology chosen. Technologies should be introduced on the basis on user's willingness and ability to pay for the service offered and the ability of the municipal authority to enforce payment and to purchase equipment and materials in the initial construction phase.

Which-ever of the technologies are chosen, it is important that designs are kept as low-cost as is feasible and technologies chosen on the basis of greatest benefit at the least cost. Willingness and ability to pay are likely to vary between low and high income groups. High income groups may be willing to pay around five per cent of their annual income for improved sanitation, low-income groups may only have two per cent or less of their annual income available for improved sanitation.

It is important that high-technology facilities for high income groups are not subsidised at the expense of lower income groups. If subsidies are to be offered they should go to the poor rather than the wealthy as this will have a greater overall public health benefit.

Existing technology
The presence of existing sanitation technologies will affect user choice as households will generally only invest in facilities which they perceive as providing an improved service to that already available. Households with no sanitation facilities are more likely to invest in most available technological options, for instance a pit latrine. However, if a household already owns or has access to a facility with high user convenience (for example a septic tank) they are likely to be unwilling to invest in a pit latrine.

Personal preference
This is very important because if the users do not like the sanitation facilities available they are unlikely to use them or maintain them properly. Often personal preference will be greatly influenced by the willingness and ability to pay of the user. If water has to be purchased or brought from a long distance users are unlikely to desire water-borne sewerage. Equally, in high income areas where there is good water supply, pit latrines are unlikely to acceptable.

There may also be cultural and religious factors which influence technology selection. Key areas this may effect in community technology choice are the need for water for anal cleansing (see below) and the acceptability of mixed-sex sanitation facilities. If communities want separate sanitation facilities for both sexes, this will raise the cost of sanitation and may mean that certain technologies, for instance sewerage, are not appropriate.

Anal cleansing method
The method of anal cleansing has important implications for technology choice. For example, certain materials may block restricted diameter pipes, or if water is used for anal cleansing this may adversely affect the performance of pit latrines especially where these are to be emptied. Where bulky materials such as corn cobs or stones are used it is inappropriate to use pour-flush latrines or restricted diameter sewerage as the discharge pipes are likely to block. Where these materials are used then dry pit latrines are most suitable. Where water is used for anal cleansing then pour-flush latrines are suitable as is modified sewerage. Paper may be easily flushed through sewers but if restricted diameter sewerage, pour-flush or low-volume flush toilets are used it may cause blockages to form.

Programme Implementation

Introduction

Programmes of sanitation improvement have frequently run into problems, many of which can be traced to poor initial planning and a lack of consultation with community and other key players. In particular, programmes have tended to fail because inappropriate technologies and delivery systems have been introduced. If the technology introduced does not perceived needs, if it too expensive or if it is delivered in such a way as to provoke a negative reaction in the user, then it is unlikely to be used or maintained properly.

Technology selection is a vital part of implementation and this must be done sensitively and be demand-led. This means that it should be the user who selects the particular technology they want for their household. Municipal authorities should actively disseminate information which will help communities and users decide what technology they require, which may include negative information about inappropriate technologies.

How programmes are implemented is also important. Communities should be involved in the whole process from initial planning, through construction to evaluation. The programme should not be imposed on the community, but rather grow with the community. Thus, ideally, it should be the community who demands sanitation and initiates technology selection. This is a long process, but in the end it is more likely to be sustainable and replicable than a programme where the introduction of an imposed technology happens very quickly.

Before any large-scale programmes of urban sanitation are started, there should be a pilot phase. This will allow governments, donors, municipal authorities and others to assess whether their approach is appropriate or whether changes need to be made. Use should be made of pilot projects to optimise the cost of sanitation and to maximise its impact. Pilot projects can also be useful when other communities wish to select appropriate technologies and levels of community management. By observing a range of technologies on pilot projects and through discussion with other communities, decisions regarding technology choice can be greatly facilitated.

Roles in Programme Implementation

Many government and municipal departments responsible for the provision of sanitation in urban areas are beginning to reassess their roles within the sector and develop their *modus operandi* so as to maximise the use of their resources. Generally, Governments and municipal authorities in developing countries have limited resources and many legitimate demands on these. Thus these authorities and departments are assessing whether direct involvement in construction of sanitation facilities is a cost-effective way of utilising their resources or whether they should, in fact, change their role to an advisory and monitoring role. In this situation they would be responsible for establishing policy and standards and monitoring the quality of construction and operation and maintenance of systems, compiling a register of approved contractors, helping resolve disputes and supporting community organisations responsible for managing their own sanitation facilities.

The construction of sanitary facilities is expensive and although a large proportion of implementation costs may come from external aid, most projects also demand an input from the implementing agency in the country. Often few resources are made available for operation and maintenance costs by donors as it is assumed that the government of the country will supply the resources required for this. This money may be difficult to find, particularly when the majority of resources allocated for sanitation have already been committed to the construction of new projects. Thus there are frequent breakdowns in existing systems due to poor maintenance and often little money for repair work. In many circumstances this is aggravated if spare parts are needed many of which may have to come from developed countries, which gives rise to a hard currency requirement.

The costs to national and local government of direct involvement in construction of sanitation facilities are long-term. Staff will have to be employed and in order to retain good staff, they may be offered permanent contracts. Even when no money is coming in from donors to build new systems, the work force must still be paid. A fleet of vehicles needed for construction must also be repaired and maintained regardless of it is required at a given time.

National Government

National government has a number of key roles to play in urban sanitation. It should promote sanitation to the urban population and to potential donors; develop national policies; ensure information about appropriate technologies is disseminated; promote and develop municipal plans; and provide guidelines for implementation.

National government is well placed to promote sanitation in urban areas to both the urban population and to potential donors. The public health benefit to the population should be stressed and the need for good sanitation as a priority in development promoted to the urban population. National government should approach the international donor community to attract funding for large urban sanitation programmes.

The Ministries and inter-sectoral committees concerned with urban sanitation should produce national policies of sanitation provision. These should include: the role of communities in planning, implementation and management of sanitation programmes; education and training strategies for health; standards for effluent and treated waste quality; construction standards and codes of practice; and strategies for long-term follow-up and support of urban sanitation programmes. These policies should outline measures to ensure that on-going operation and maintenance schedules can be adhered to and ensure that all those responsible have the requisite training and access to equipment and spares.

A range of technologies that are appropriate in urban conditions should be identified on a nationwide basis. This information should be disseminated through local government to the communities who will be responsible for the final technology choice. If the community are to make a rational decision based on the health benefit provided by the facility, how difficult and expensive the facility will be build and maintain, how easy it is to use and whether it is technically feasible for their area they must have access to full information about each technology in an understandable form. All technologies should be evaluated in terms of their appropriateness and clear guidelines established for where individual technologies are appropriate and where they are not.

Guidelines should be developed for the introduction of urban sanitation technologies on a nationwide and city-wide basis by national government. These guidelines should be disseminated to local government and used to develop municipal strategic sanitation plans with national agencies providing advice and support to local government.

It is important that national government ensure that proposed programmes of urban sanitation improvement are tested on a pilot scale, to assess whether they sustainable and replicable in other urban areas within the country and provide a good working model for other municipalities to follow. All technologies deemed appropriate for urban sanitation should be tried on pilot projects prior to any large scale implementation to ensure that the technology is appropriate and satisfies the population's needs. Communities should be given the chance to observe the pilot project in operation and discuss with staff and the communities involved the suitability and problems of the technology. This will help communities to decide what type of technology and what level of management they are willing to provide.

Surveillance

National government should, preferably, ensure fulfilment of the surveillance function by the creation of an independent body which is represented at national level and has operational capacity at regional level. It is important that the surveillance of discharges and effluent quality should be done by an agency other than that responsible for construction, operation and maintenance of sanitation facilities so as to avoid any conflict of interest. Even where municipal authorities are not directly responsible for construction, they are likely to managing contracts with private companies and thus a potential conflict of interest still exists.

The most suitable sector to take responsibility for the surveillance programme in many circumstances may be the health sector, as the protection of public and environmental health is of paramount importance in enforcing compliance with quality standards. The health sector may already employ professionals with the skills to conduct a surveillance programme, and if not should be able to attract suitably qualified staff. An alternative approach may be to establish a completely independent surveillance body composed of personnel from civil service, academic and private sector backgrounds. No matter how the surveillance body is organised, it is important that it receives adequate funding to carry out the assigned and has real political and legal power to enforce compliance.

The surveillance body should be staffed by qualified engineers, scientists and health inspectors or

environmental health officers who have a good understanding of how a surveillance programme should be implemented and are backed up with a range of statutory measures to enable enforcement of compliance with standards.

The surveillance of sanitation is likely to form part of a larger programme which may assess other aspects of environmental health such as water supply quality and solid waste management and, possibly, food quality. It is important, that sanitation receives due attention, as many of the problems caused from poor environmental health are influenced to some degree by the coverage and quality of the sanitation provision. Surveillance staff should be responsible for the on-going monitoring of environmental health conditions and investigate complaints of pollution events and deterioration of environmental health conditions. They should have the support and access to legal mechanisms to enforce compliance with quality standards and the means to prosecute offenders. These officers should monitor all activities relating to environmental health and ensure that an adequate quality of service is provided.

The surveillance body should monitor effluent discharges and treated waste from sewage treatment plants and industrial complexes and enforce compliance with statutory regulations of effluent and treated waste quality. It should also monitor disposal of waste from septic tanks and pit latrines, leachate from landfill sites where solid waste is buried and comment on overall urban sanitation coverage. At national level, through overview reports to the inter-sectoral committee, the surveillance body may also play a promotional role ensuring that proper sanitation remains a priority at a national level.

In many African countries, such as Ghana and Kenya, the need for a national independent surveillance body is recognised and being implemented, although funding remains a problem. It is important that the surveillance body has real powers and consequently needs adequate funding to attract appropriate staff and equip laboratories. Unfortunately, to date even in countries where independent bodies have been established there has often been a lack of funding and this has led to limited impact of surveillance in improving environmental conditions.

Municipal Roles

Municipal authorities have traditionally been responsible for the provision of urban sanitation, and in many African countries this may still be the case. However, they have generally suffered from a lack of sufficient resources to serve the entire population and as a result only the wealthier sections of urban areas are now commonly served by sanitation facilities.

The continued belief amongst engineers and planners that conventional sewerage and sewage treatment works are the most suitable methods of sanitation provision in urban areas has exacerbated this. Resources in many African cities have not even been sufficient to keep what sewerage and treatment systems they have functioning properly. The result of these constraints has been gross contamination of the urban environment and it's surroundings. Consequently, many municipal authorities are reassessing their role in urban sanitation provision to evaluate whether construction is a cost-effective method of deploying limited resources. Some municipal authorities now propose to contract construction out to the private sector and to NGOs and concentrate their resources on a monitoring and advisory role.

Where the private sector or NGOs are responsible for construction of facilities, all programmes of construction should be approved by the municipal authority and it is important that overall management of the provision of sanitation facilities to the urban population remains with the municipal authorities. Thus, whilst municipal authorities may not be actually constructing facilities, they should be responsible for approving designs and estimates and should be responsible for monitoring progress and quality of construction.

Municipal authorities should use the information available to them concerning the make-up of the city and using the national guidelines to develop strategic plans for sanitation improvement and how such programmes should be implemented. The is may be done on a 'housing-type' area approach, that is the city is divided into areas corresponding to housing types and income levels with a range of appropriate technologies which may be appropriate to the community during technology selection in each area. The municipal authority should also monitor the coverage of the population with sanitation and use this information to update their plans.

It is important that when municipal authorities are establishing sanitation programmes that minimum service standards are established and enforced. This may help to clarify what is expected from individual households in terms of environmental health

improvement and what builders of new dwellings should provide. An example of the strategic planning approach with regard to technology selection and service standard formulation is given in Annex 4 and which outlines the approach of Kumasi Metropolitan Authority in Northern Ghana.

Staff from government or municipal work forces may be seconded to construction programmes with the programme being responsible for paying an allowance. Staff such as engineers, technicians and health educators may be assigned to work alongside the staff of the company or organisation responsible for construction. This has three advantages:

- municipal staff have direct experience of working on the project and a good understanding of how the technology works, the major causes of breakdown, the operation and maintenance routines and repair work;

- the implementing agency have access to qualified and experienced staff who have local knowledge;

- staff get a chance to gain valuable experience on appropriate projects which strengthens the institutional capacity of the country to replicate and sustain successful programmes of urban sanitation provision.

In order to facilitate the monitoring and management of construction projects, the municipal department responsible for sanitation (and possibly other environmental health concerns like water supply and solid waste disposal) should establish a contracts and commissioning department who will issue requests for tenders and manage contracted projects.

The contracts department should be staffed by well qualified engineers and headed by a senior engineer with extensive management and sanitary engineering experience. Junior engineers should be attached to the department to ensure that they get relevant work experience. The contracts department should also contain financial staff to assist the engineering staff in assessing potential contractors, tenders and monitor the quality of service. The financial staff will assess tenders and bids for contract work to see if they meet the guidelines set by the municipal authorities and national government, whether contractors are financially able to fulfil their commitments and to ensure that reasonable charges are levied on the users for construction of facilities, waste removal and treatment of wastes. Health professionals may assess proposed plans submitted by contractors to ensure designs will provide the required health benefit and advise engineering staff on the improvements required in order to meet statutory health regulations.

Contract department staff should for keep a register of all approved organisations, individuals and companies which are licensed to construct sanitation facilities. Standards for design and construction should be set by the department following national guidelines and these should be monitored and enforced by department staff.

In some countries surveillance may still fall in the municipal authorities remit. Where this is the case the surveillance body should be kept quite separate from the contracts/construction department up to a senior level. Thus each section would be headed by a deputy director, or equivalent, who both report to the head of the environmental health services or equivalent.

Construction

If local or national government are not going to undertake the construction of new programmes of urban sanitation then suitable agencies for implementation must be identified. There are two principal types of agency which may be considered when looking for an executing agency:

Local or international commercial contractors. The use of contractors has been successful in a number of urban sanitation programmes in developing countries and on larger projects with higher capital requirements and little community management, operation and maintenance, they can be effective. Where commercial contractors are employed it is important that clear standards for construction and operation and maintenance are set by the appropriate municipal department and these are regularly checked.

When a project is proposed by a municipal authority or government which is to be put out to commercial tender it must be ensured that the contractor can: demonstrate the level of technical expertise required; has sufficient resources or financial backing to be able to finish the construction work; can work with communities in a sensitive and collaborative manner; is registered contractor with the municipal authority; and, preferably, has a good record of timely completion of contracts.

There is always potential that tendering procedures may be undermined by fraudulent practice. It is the responsibility of both the contract and the surveillance bodies to be vigilant and that offenders are dealt with rigorously, for instance immediate disqualification from tendering for other contracts anywhere in the country for a pre-determined period of time.

It has become a common perception that private contractors can provide sanitation facilities in urban areas at a lower cost and more rapid rate than municipal authorities. This is based largely on the performance of the private sector in other areas which has often been better than government performance. However, this approach appears not to have been tested on a long term large sanitation programme and some caution should be exercised when advocating private sector involvement. Nonetheless, documents like the Kumasi Metropolitan Area Strategic Sanitation Plan give a detailed breakdown of proposed private sector involvement in sanitation provision which certainly appears feasible.

A pilot project(s) using this approach is needed which should run for a number of years (at least five) to see whether it is workable in reality. Certainly for the higher income groups there is little doubt that the private sector can provide the services required at a cost the users are willing to pay. The lower income groups may not be in this position, thus some form of subsidisation may be required. This can either be through loans and grants to householders (as proposed in the KMA Strategic Sanitation Plan), direct payments from municipal authorities to contractors, or by using either government or NGOs to provide facilities in the lower income areas.

NGOs and community organisations. The use of NGOs and community based organisations for the implementation of sanitation provision, particularly in poorer areas of cities, is widespread and can be effective. These programmes often attract external funding and in this case do not place a great burden on municipal resources. The majority of such programmes focus on the provision of sanitation facilities to low income groups and in such a way as to promote community level management of technology. Commonly latrines and modified sewerage systems are provided with the community expected to provide a significant contribution towards recurrent cost, labour and operation and maintenance. These schemes have been very successful in many poor urban areas, for instance the KWAHO project in the Kibera area in Nairobi.

Many low-income areas in developing countries are informal and illegal settlements. Due to the nature of these settlements, governments are often reluctant to provide 'official' basic services as this may be interpreted as formalising or legitimising the settlement. It is perceived that this is likely to encourage new informal settlements in the hope that this will also in time be formalised. Due to the insecurity of their tenure on land, many inhabitants of low-income and informal areas are unwilling to commit time and resources to develop basic services for the community as they feel that this may be taken away from them at any time. Landlords are also often reluctant to commit their resources to service development and wish to maximise profit.

This was the scenario in Kibera but through negotiation and sensitisation, KWAHO have managed to provide 'makeshift' basic services with the cooperation of the municipal authorities. This settlement is informal in nature and had virtually no basic services such as water, sanitation or solid waste removal. Water had to be bought from vendors who sold the water at very inflated prices, solid waste was allowed to build up in the lanes and streets and the majority of the population practised open air defecation as there were few latrines available for use.

With the assistance of KWAHO, the community have now formed groups who manage water points connected to the main supply. Water is sold from these kiosks, but at a far lower price than from commercial sellers. Latrines are being put up in the area paid for by the landlords of the dwelling which are emptied on a six monthly basis and garbage is burnt on weekly basis. Landlords were persuaded to install latrines by their tenants (some of whom threatened to withhold their rent until sanitation facilities were supplied) and by discussion with KWAHO staff. Although conditions are still far from perfect, the Kibera project does illustrate just how much can be done in areas which are often perceived as difficult to work in and where there is no official municipal policy of upgrading.

Operation and maintenance

Who is responsible for operation and maintenance will largely depend on the type of technology used, what level of community organisation exists and the users' income. In high-income areas in most African

cities where either conventional sewerage or septic tanks are used, all operation and maintenance is likely to be carried out either by the municipal authority or by a private company contracted to do the work. This contract is likely to be with the municipal authority but may in some cases be directly with the users.

In many low-income areas operation and maintenance may be carried out by a wide range of individuals and organisations. On-site technologies may only require pit emptying and the user or a private contractor may be responsible. Some modified sewerage systems have relatively complex operation and maintenance requirements which may be undertaken by contractors or municipal authorities. However, in some programmes, such as the Orangi Pilot Project in Lahore, Pakistan, the community themselves were trained to do much of the routine cleaning and inspection of sewer lines and external help only sought where major problems arose.

Pit emptying: is area where the potential exists for the private sector to play an important role in providing adequate sanitation services. It has been commented that pit or septic tank emptying should not be entrusted to the private sector as they are likely to break codes of practice and dump untreated waste at the nearest convenient spot rather than take it to the designated treatment plant or landfill site. However, in practice it has been shown that private operators can provide a flexible, inexpensive service to users and can often reach parts of urban areas that municipal fleets find difficult because of access problems.

In 1991/1992 a study was undertaken in Dar es Salaam to look at methods of pit and septic tank emptying. Two of the methods were municipal operated mechanised vacuum exhaust tankers which could empty more than one pit before emptying the vacuum tank, the third method was a manually operated system of pit emptying using handcarts and which was privately operated. In terms of consumer satisfaction and value for money it was apparent, particularly amongst lower income groups, that the privately run system was viewed as a superior service to the municipal service. This was largely because it was cheaper, quicker and more flexible. The price for emptying was negotiated between the customer and supplier and prices were kept affordable as the technology used was low-cost and used manually powered equipment which could be repaired locally.

The private emptying teams offered a range of services such as partial emptying, to match consumer needs. The waiting time for pit emptying was much shorter for the private teams who generally arrived within a week of agreeing to empty a households pit. The large municipal trucks took several weeks before fulfilling the contract, often did not fully empty the pit whilst charging the full emptying fee, could not access all sections of the city and gave a generally poorer level of service.

Where private contractors are used for emptying of pits and septic tanks it is important that they are aware where the waste should be taken and regularly monitored to ensure that they do take waste there. The surveillance body should have statutory measures to enforce compliance with regulations concerning the dumping of waste and waste handling practices, and should be able to revoke operators licences if they break these regulations.

Where full pits are left for at least two years the household may be responsible for removing the contents or a private contractor may be used. The waste may be then either used on the family's own farming plot or sold to someone else who has land.

Sewage Treatment

The sewage treatment works may be operated and maintained by the municipal authority or in some circumstances by private water and sewerage companies. Treatment works may receive only domestic sewage, or combined domestic and industrial sewage. It is generally better to separate domestic and industrial waste with the industrial waste treated on site. This is because it is easier to treat industrial sewage in a concentrated form than when it is diluted by domestic sewage. Industrial wastes commonly contain significant levels of highly toxic heavy metals and other chemicals whose removal is more difficult and much more expensive once it is diluted. It is also relatively easy and inexpensive to treat domestic waste so that it can be reused or discharged into the environment without representing a significant health risk.

If reuse of treated waste in agriculture or aquaculture is considered, then treatment works should only receive domestic waste as there will a high health risk if toxic industrial waste is used as irrigation water or soil conditioner. Where sewage is separated then industry should be responsible for pretreating their effluent prior to discharge into municipal

sewerage systems or into receiving waters, where necessary. Effluents should be monitored to ensure they meet quality standards and measures should be made available to enforce compliance.

Care should be taken to monitor discharges from both domestic sewage treatment plants industrial discharges, landfill leachates and treated waste being reused to ensure that they meet the national quality standards. These standards should be enforced and a 'polluter pays' principle established for remedial work and persistent contravention result in more severe action. An independent, preferably national, body should be responsible for monitoring discharges and should have the legal and political power to enforce compliance and prosecute offenders. This may be part of the Ministry of Health, Ministry of Environment or a separate surveillance body. This is discussed earlier in the text.

Where the municipal authority is responsible for the operation and management of sewage treatment plants, there may still be role for the private sector in the reuse of the treated waste and effluent. Effluent from waste stabilisation ponds can often be used as irrigation water provided it meets the quality standards outlined earlier. The municipal authority can either sell the effluent direct to farmers, use it on its own irrigated property or sell it to an intermediary who then sells the effluent to farmers. One potential use is to supply the effluent at low-cost to low-income farmers from the urban fringe to help develop their agriculture to be more productive. This will help in the country's overall development by promoting growth at the poorer ends of society and encourage a fairer distribution of wealth. However the reuse of effluent is organised it is vital that the effluent meets the required quality standards and that measures are in place to enforce compliance.

Maturation ponds can be used for aquaculture and could be rented out to fish farming groups to help recover costs or the municipal authority can itself become involved in aquaculture. Treated solid waste can be used as a soil conditioner on farms or on forestry projects.

The contents of pit latrines which are left for two years (and possibly also composted) can be used as a soil conditioner and fertiliser. The contents of pit latrine may be used by the household for use on their own farming plots or sold to farmers or other urban dwellers who have land. It is important that the municipal authority monitors the reuse of pit latrine wastes to ensure that they are left for a sufficient amount of time to be safe. This is a minimum of two years for dry latrines and longer if the pits are wet. Under no account should raw excreta be used as a soil conditioner as this represents a significant health risk to both the farm workers and the consumers of the produce.

Health Education

Health education should be provided under the direction of the health sector and implemented as a complimentary programme with construction programmes. In urban communities with poor sanitation there is commonly a need for health education, and even in higher income areas, clinics and health workers should promote good sanitation and hygiene behaviour. Health education is an on-going process which should start before construction of sanitation facilities begins and should carry on after the construction phase is over. If a programme is well designed and local communities empowered to provide their own health education, it should become self-sustaining.

Given the long term nature of health education it is most appropriate for it to be provided under the direction of the health sector, either by health sector staff or by local NGOs. Inputs from international NGOs and ESAs may help in the development of suitable materials for health education programmes, to train staff and community members as health educators, to fund pilot projects and to strengthen local institutional capacity to conduct training and promote health education. However, in the long term it is the communities, their indigenous organisations and the local authorities who will make the health education programme sustainable. Health education programmes should be replicable so that a basic format of urban community health education can be establish for the country. This will help to standardise the quality of education provided nationwide.

It is vital that health education is seen as a continuous process and one that requires the support not only of communities, local NGOs and municipal authorities, but also from the health and education sectors and at local and national level. In the long term the health benefits that can accrue from improved urban sanitation will only be fully realised if the population understand and practice safe hygienic methods of excreta disposal and personal hygiene.

Annex 1: Issues to be Addressed in Developing Training Capacity

To ensure that sanitation interventions are sustainable, it is important that African countries develop adequate training which will provide them with the quality of staff they require. A comprehensive human resources development strategy should be developed at a national level which identifies the education and training needs for sanitation and how these should be met. Appropriate courses of study in public and environmental health related subjects should be established and links with institutions of higher and further education within each country and elsewhere developed. Career structures for staff linked to progressive training should be established to allow staff to progress within the sanitation sector.

Issues to be considered in the establishment of appropriate training structures for all concerned with urban sanitation can be summarised as follows:

Universities: strengthening of existing higher and first degree courses in appropriate engineering, scientific, health, education and community development disciplines which have a significant element of sanitation related topics. Where these do not exist then institutions in developing countries should be encouraged to either establish appropriate courses or to set up options within appropriate existing courses. Engineers and scientists should be given training in basic health concepts and education techniques. Education, health and community development staff should be given basic training in public health engineering and science. Modular courses and national diploma courses should be encouraged and provision made to include experienced mature students with lower formal education to attend courses. Utilisation of external staff with appropriate qualifications to strengthen course content. Institutions should be encouraged to establish links with other institutions within each country, the region and outside to increase teaching capacity and encourage networking.

Technical colleges: strengthening of existing institutions providing courses in environmental health, health education and technical trades at diploma or certificate level. Where these do not exist institutions should be encouraged to establish such courses. Decentralisation of training provision to allow students throughout the country to receive training in the area and not have to travel to capital cities or the largest urban centres. Courses which provide good technical and education skills should be established, with training in small business mangement also given. The focus for education professionals should be on participative techniques and all students should receive training in health promotion and education techniques. Modular and part-time courses should be encouraged and provision made for mature students with lower formal education to attend courses. Courses for the training of trainers should be established to assist in community training. Utilisation of external staff with appropriate qualifications to strengthen course content.

In-service training: this should include workshops and training courses and be regular to keep staff up to date with the latest developments, to provide refresher training and to exchange experience. Courses should be short, participative and focussed on particular subjects with direct relevance to work in the urban sanitation sector. Use of staff from other programmes and from outside agencies should be encouraged.

Community training: this should be participative and provided through workshops and demand active community involvement at all stages. Health education should focus on key messages such as hand washing after defecation and before eating. It is important that health education provides an impetus for communities to demand sanitation as a basic service, to construct, operate and maintain facilities properly and to ensure that community members use facilities properly. Materials and teaching aids should be used sensitively and must be pre-tested prior to use to ensure that they are understood and accepted by the target audience. Able members of the community should be trained to work as local community health promoters and given support and backup from the programme. Where local artisans are to be trained they should be given a thorough practical training in construction techniques, contract tendering and mangement.

Annex 2: Technical Documents For Sanitation Design

The following are documents that will be useful in assessing design criteria for sanitation facility design and associated activities:

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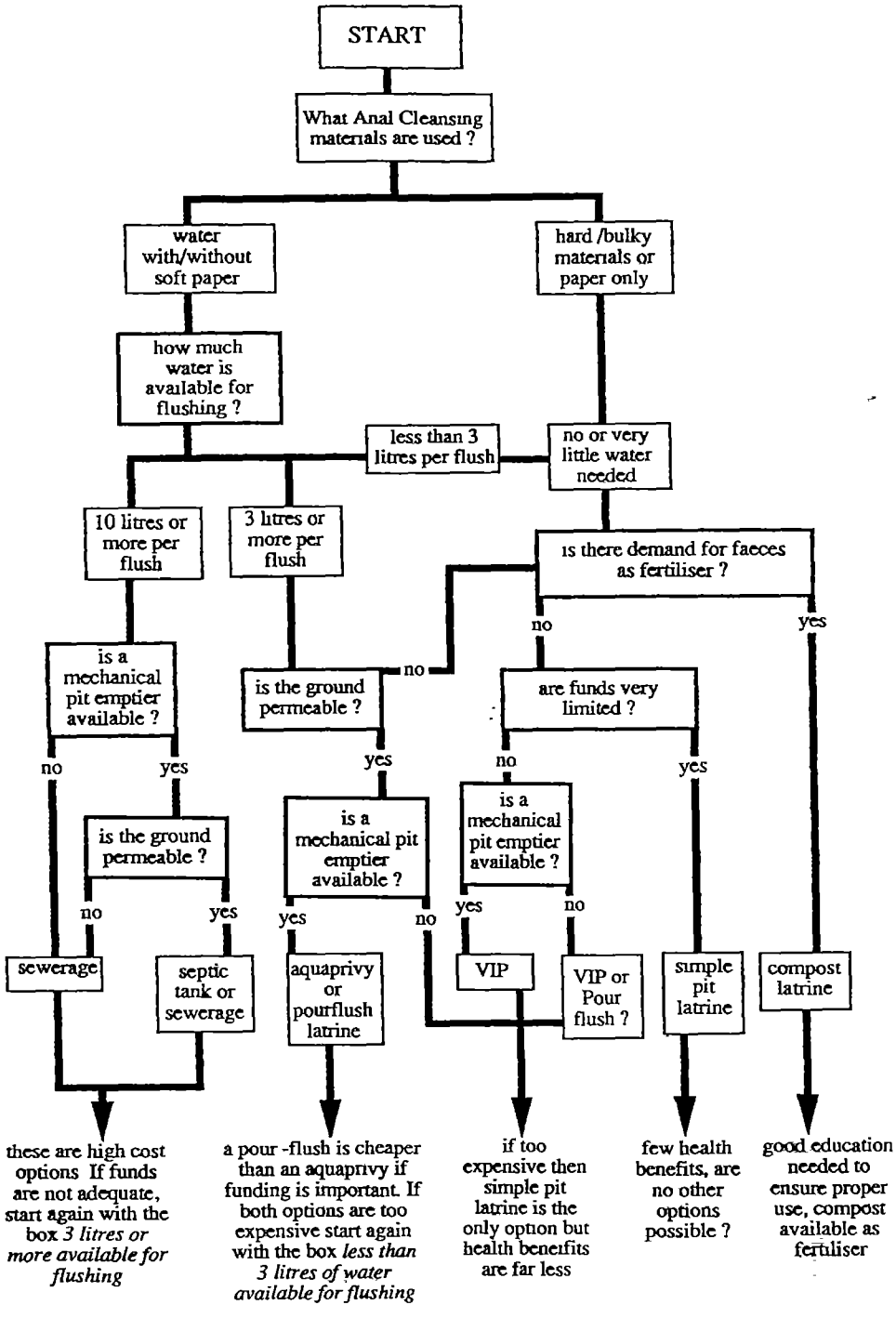
Waste Stabilisation Ponds: A Design Manual for East Africa, D.D. Mara, G.P. Alabaster, H.W. Pearson and S.W. Mills. Lagoon Technology International. Leeds. 1992.

Annex 3: Sanitation Technology Selection



Annex 4: Strategic Sanitation Plan for Kumasi Metropolitan Authority, Northern Ghana, UNDP-World Bank.

The Strategic Sanitation Plan for Kumasi Metropolitan Authority was produced in 1991 with UNDP-World Bank support. The relevant sections relating to technology choice and service requirements is summarised below.

Kumasi is a city of 600,000 people, 75 per cent of whom have no access to domestic sanitation facilities: 40 per cent use public latrines, 25 per cent use bucket latrines, 5 per cent use traditional pit latrines, 5 per cent defecate in the open and only 25 per cent have access to household water closets. About 90 per cent of the communal and domestic bucket latrines are emptied into open streams or vacant lots. The storm drains are essentially open sewers and the river Oda is grossly contaminated for a number of miles downstream.

A strategic sanitation plan was developed to address these problems and reduce the health risk to the population by the isolation, removal and treatment of excreta. Only those sections relevant to the infrastructure section of this paper are outlined below.

A minimum service standard was developed for all households in the city as follows:

- pan latrines are prohibited;

- discharges of excreta at both new and existing residences, and discharges of sullage at new residences is prohibited; these waste must be contained on one's property or conveyed off-site through an approved sewer system.

- where depth to the water table is less than two meters, on-site systems may not be constructed for new housing; however, on-site systems may be constructed for existing housing where the depth to the water table is less than two meters if toilet waste is segregated from other waste water and disposed of separately;

- the construction of new public sanitation facilities is permitted only in markets, light industrial areas, schools and institutions;

- Kumasi double ventilated improved pit (KVIP) latrines or flush toilets (pour-flush or water closet/septic tanks) are required for home installations;

- household, public and institutional facilities must be constructed according to the designs and specifications set out in the 'Guidelines for the Construction of Sanitation Facilities';

- discharges of industrial waste water from new and existing industries should be as far as practicable be contained for pretreatment at the industrial location and can be discharged into the city's sewer system or receiving waters only when they meet the quality standards dictated by the bye-laws of KMA.

For the purposes of the strategic plan, the housing in Kumasi was divided into four main groups:

- tenement area, most residences are in 2-3 storey buildings having 20-30 rooms shared by 10-20 families (40-100 persons). Population densities between 300 and 600 persons/hectare. Total of 25 per cent of all households.

- indigenous area, homes usually single storey buildings with 5-10 rooms shared by 4-10 families (20-50 persons). Total of 53 per cent of all households.

- new government area, housing for the most part of single storey buildings in constructed rows. Usually one or two households per building. Total of 16 per cent of all households.

- high-cost areas, mostly detached, single storey buildings with large plot sizes and low population density. Total of six per cent of all households.

After the definition of these housing types and assessing a range of potential technologies the strategic plan recommends the following technologies be offered to communities as appropriate for use in Kumasi:

- tenement areas: simplified sewerage. this was selected because the high density of housing precluded the use of pit latrines or construction of septic tanks. Those septic tanks in use in the area currently discharge their liquid waste into the street drains thus posing a significant health risk.

- indigenous area: on-site technology, users to be given a choice of VIP, pour-flush latrines or septic tanks, based on their willingness to pay.

- new government: all have septic tanks, but some of these are underdesigned for the wastewater flow and so generally overflow into the street drains. Either sewers or septic tanks should be constructed for new housing and where overflowing occur either communal sewers or drain fields should be constructed.

- high-cost: as these areas have internal plumbing, either septic tanks with on-site effluent drain fields or simplified sewers.

All technologies were matched with technical feasibility, social acceptability and users willingness to pay for improved services with subsidies and loans were to be available for low-income areas.

The strategic plan is aimed at phasing out all bucket latrines by the year 2000, and to provide sewerage connection to 26 per cent of the population, septic tanks to 17 per cent and a VIP design using twin pits to 45 per cent of the population by the year 2000. No further public latrines were to be built except at communal areas such as markets and lorry parks, although some existing public latrines serving very low-income areas would be retained.

Annex 5: Acknowledgements

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Mr Greg Goldstein, RUD/WHO, Genēva, Switzerland.

Miss Karin Loch, Land use planner, Edinburgh, Scotland

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This report was prepared inlight of comments received from practitioners and extensive review of available literature. Principal source documents are listed below:

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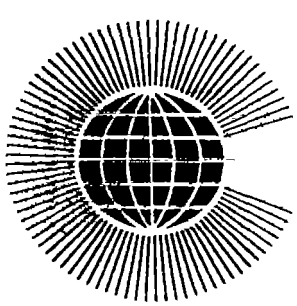
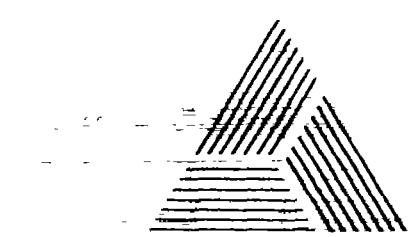
Infrastructure and Training Needs for Sustainable Urban Sanitation in Africa:

Appendix: Recommendations for Action



Commonwealth Secretariat



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Infrastructure and Training Needs for Sustainable Urban Sanitation in Africa:

Appendix: Recommendations for Action

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Infrastructure and Training Needs for Sustainable Urban Sanitation in Africa: *Recommendations for Action*. Guy Howard and Jamie Bartram.

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1993

This document is the appendix to the report 'Infrastructure and Training Needs for Sustainable Urban Sanitation in Africa' (ISBN 1 85 23 711 45) and is part of the output of a study undertaken by the Robens Institute on behalf of the Commonwealth Secretariat. A literature review and field visits to Kenya and Ghana were undertaken to access current practice, collect relevant experience and discuss future developments. This appendix is prepared as general recommendations for actions to be taken to promote and achieve sustainable urban sanitation in Africa, the style and content of which were discussed and reviewed with the Commonwealth Secretariat.

Executive Summary

The need for adequate sanitation in urban areas of Africa is a pressing problem and one that must be addressed as a priority because of its importance to public health. Poor sanitation is a significant factor contributing to the high morbidity and mortality rates commonly associated with poor urban areas, particularly amongst infants. Increased access to and use of improved sanitation and water supplies in urban areas will contribute significantly to the reduction in the incidence of disease in the urban population. To achieve this will involve a multi-sectoral approach and the need for sanitation promotion at all levels. The health sector should take an important role in policy development, standard setting, strategic planning, monitoring and health education.

When assessing the problems of urban sanitation, particularly provision of services to the urban poor, it is clear that there are a number of factors which influence the sustainability and replicability of programmes of sanitation improvement. Institutional, infrastructural and educational factors will all affect sustainability and replicability and it is important these are addressed preparatory to the start of sanitation programmes.

Institutional strengthening may be required in many countries and the roles that central and local government, external support agencies, non-governmental organisations and the private sector play in urban sanitation defined. Responsibility for construction, operation, maintenance, monitoring and management should be decided at a national level and strategic plans prepared for urban sanitation improvement.

There is in general a shortfall in trained staff at all levels to implement sanitation and health education programmes. If sustainable urban sanitation is to be achieved, there is a need for improved and/or increased education and training of staff working in sanitation. Of particular importance is the development of appropriate educational and training courses within African countries which focus on the real problems affecting each country and which can supply professionals to work in sanitation construction, operation and maintenance. Institutions should be encouraged to develop links with other institutions in the region and elsewhere to increase capacity for training and research.

Technology choice is critical. The introduction of inappropriate technologies in African cities has caused widespread problems of low acceptability, poor maintenance of facilities, frequent breakdowns and limited repair work. Technologies should be identified which provide a health benefit, are affordable, acceptable and can offer, where appropriate, a significant level of community based operation, maintenance and management.

Realistic charges for sanitation facilities must be levied if sanitation programmes are to be sustainable. Where incomes are low, sanitation programmes in African countries should aim to empower low-income groups and in particular women, to accept an increased level of responsibility for the management of sanitation facilities. If health benefits from improved sanitation are to be realised, it is important that good hygiene practices are adopted by the population. To facilitate this, health education programmes run in parallel to construction programmes are required. This will generally be the responsibility of the health sector, but is likely to require input from other sectors. The provision of community health education with particular emphasis on sanitation and good hygiene practice is vital to ensure that once facilities are available they are used and maintained properly.

The health sector has an important role to play in urban sanitation and should develop a coherent approach to the health problems associated with poor sanitation. Policy development, strategic planning, provision of health education in parallel with construction, inputs to higher and further education courses in public health-related disciplines and the establishment and monitoring of standards of effluent and waste quality are all likely to fall within the health sector remit. Where the sector does not have the necessary expertise to fulfil all these roles, then cooperation with other sectors, such as education and local government will be particularly important.

Of particular importance for the development of sustainable urban sanitation programmes in Africa are policy development and strategic planning at national and regional levels which address the public health problems of insanitary excreta disposal in

urban areas. These should emphasise public health improvement and create an enabling environment for this to be achieved. This may involve the setting of adequate standards for construction, water and effluent quality, by implementing routine monitoring and inspection programmes which have the power to enforce compliance with quality standards and the development of appropriate education and training.

The promotion of community-based interventions to improve urban sanitation will become increasingly important, particularly to meet the needs of the low income urban populations. It is these groups who have least access to sanitation, are exposed to the greatest public health risk and who are least able to pay municipal authorities for the cost of operation and maintenance by municipal staff. Through the development of strategies which encourage community construction, operation, maintenance and management of sanitation facilities, the potential for urban sanitation improvements to be sustainable will be significantly raised.

The development of increased opportunities for appropriate education and training for those interested in pursuing a career in public health and staff already employed in the sector is important to increase the number and quality of sanitation staff. In particular the development of a cadre of field staff who can undertake a wide range of public and environmental health work in low income communities are needed. These staff will be community based fieldworkers who can undertake a wide range of public and environmental health interventions ranging from construction of water supplies and sanitation facilities to providing basic health education and monitoring environmental quality. These professionals should also be able to learn from and share their skills with community members, particularly women, to enable them to take increasing responsibility for the environmental quality of their surroundings.

Interventions in these areas will provide the political will to achieve improvements, increase the likelihood of commitment of sufficient resources to realise those improvements and raise the numbers of available skilled personnel with which to achieve these targets.

Proposed Action for Sustainable Urban Sanitation

This document is the appendix to an overview paper considering the infrastructure and training needs for sustainable urban sanitation in Africa produced by the Robens Institute for the Commonwealth Secretariat. An objective of this paper was to identify a small number of areas in which activity was a priority because of the public health need and in which intervention is likely to have a positive impact. Factors such as replicability and international relevance were therefore important.

To address the issues highlighted above, it is recommended that consideration is given to projects in three key areas:

- the development of flexible, progressive education for with a strong practical focus for field staff involved in urban sanitation or other environmental/public health projects and those wishing to pursue a career in environmental health.

- strategies to support the development of policy making at national level and to promote exchange of information at senior policy making level.

- identify existing projects of urban sanitation provision, promote their establishment where absent and specifically support exchange of experience between projects through seminars, conferences and newsletters.

Outline proposals for projects to support each of these initiatives are presented on the following pages.

Environmental Health Education

Introduction

The need for a cadre of well-trained professional environmental health staff was clearly highlighted in the paper prepared for the Commonwealth Secretariat on training and infrastructure needs for sustainable urban sanitation. Well trained and qualified staff who can undertake technical work in addition to environmental health inspection are currently one of the least available groups in Africa. The training of such a group should be seen as a priority in national human resource development programmes for most African nations. These staff should be trained to the equivalent of higher diploma level.

Students who graduate from such a course are likely to be employed as field staff who will work in and with urban communities, particularly low income groups, to improve environmental and public health conditions. Such a cadre would include individuals who can take responsibility for: construction of sanitation facilities; construction of water supplies; monitoring and sanitary inspection of water supplies; monitoring of discharges from both industrial and domestic sewage treatment works; building inspection and drainage provision; and for providing hygiene education. Of key importance will be the ability of such staff to be able to transfer their skills and provide advice to the communities with whom they work.

Project Strategy

It is proposed that this course be implemented as a pilot project in several countries which can either function as regional (international) training centres and/or as demonstration projects for other countries in their region. As there are two Commonwealth regions in Africa (West Africa and East, Central and Southern Africa) it is recommended that one pilot project be set up in the West Africa region, as this only comprises four countries, and two in the East, Central and Southern Africa region. It is proposed that these be in Ghana to serve the West Africa region and Uganda and Zambia to serve the East, Central and Southern Africa region. It is important to note that these pilot courses should be used as a demonstration for all African countries in each region and not only Commonwealth member states.

These courses should preferably be run in existing education institutes rather than establishing new facilities. The most suitable institutes would be technical colleges or polytechnics, but a university could also be used. Although this course would be designed to meet the needs of fieldworkers at a higher national diploma level, if there is sufficient demand it could also be seen as the basis for the development of environmental and public health courses of a higher level. The development of this course should be seen as part of a wider human resource development programme aimed at satisfying the needs of all levels of staff working on environmental and public health projects.

To ensure that this course addresses real needs it would be important before its establishment that regional, state and municipal authorities are consulted, as well as the private sector and External Support Agencies (ESAs) and Non-Governmental Organisations (NGOs). The demand for training and the perceptions of the training needs of their current staff and level of future staff will help to define where emphasis is required and to finalise course content.

Training Structure

The aim of this course to provide flexible, appropriate education in environmental health for field staff who work or plan to work on urban environmental health programmes. The proposed course should be structured so as to allow students to take this course on a modular basis. The course will also be open to older staff with relevant experience but possibly lower formal qualifications.

The course should last for three years if taken in one block and would be suitable for students who have recently left secondary school with reasonable grades, particularly in technical and science subjects. However, being modular, the course would be available for staff currently employed on environmental health programmes to study without leaving their positions for too long a period. The modular approach also aims to increase access for poorer students who may not be able to afford to follow the course full time.

The course would be practically orientated with

students acquiring skills which can be used directly in urban communities and would cover all aspects of environmental health including sanitation. The course would be taught through a mixture of: lectures; practicals; group and individual projects; case studies; and field visits to urban areas both with and without existing sanitation facilities. Students would be expected to undertake either a group or individual project in an appropriate field in urban environmental health. The need for these to be practical is emphasised to allow students to utilise their skills. Examples of suitable projects would include: employment on an existing urban environmental health programme, establishing a small scale sanitation project and construction of small water supplies in a low income urban area. Graduation will be on successful completion and passing of all modules in the course and satisfactory project report from the tutor and/or employer where appropriate.

Course content

There will be three key themes to the course: construction and technology (water supplies, sanitation, drainage and building); education (hygiene, environmental and public health); and inspection and monitoring (water supplies, sewage discharges and households).

Construction and technology:

This section will cover the principal technologies and construction techniques employed in environmental health engineering, with particular emphasis on low cost options for low income groups. The course will be orientated towards the practical application of construction techniques and uses of different technologies. On completion students should be able to plan, design and construct simple water supplies, sanitation facilities, basic structures and drainage for low income groups.

This section will be split into four modules: a foundation in construction and technology; sanitation; water supply; building and drainage.

Foundation - engineering and health; concrete mixes; concrete types (ferrocement, reinforced concrete, unreinforced concrete); uses of blocks, bricks and mass concrete; health and safety at work; basic plumbing; materials estimation; simple surveying.

Water supply - water and health; the water cycle and basic hydrology; groundwater; simple water engineering; hand dug well construction; handpumps; spring protection; tubewell sinking; rainwater harvesting; small storage tank construction; operation and maintenance; basic water treatment; community participation and management.

Sanitation - excreta and health; on-site sanitation technologies; water-borne sanitation; on-site sanitation construction; solid waste management and wastewater treatment; composting and reuse of wastes; technology selection; community participation and management of sanitation; groundwater protection.

Building and urban drainage - buildings and health; good building practice; brick laying; basic joinery; roofing; vector control; on-site sullage removal technologies; urban drainage and health; stormwater drainage.

Education:

This module will focus on community education techniques and material development.

Education techniques - setting objectives; selection of target audience; collecting information; communication and participatory learning; meetings and workshops; mass media; drama, stories and songs; training of community health volunteers; baseline surveys.

Material development - selection of media; visual and audio materials; monitoring and evaluation of education materials; local production of materials; community training in materials use and development.

Inspection and monitoring

Water supply - water quality and health; biological, chemical and physical properties of water; critical parameters of water quality; drinking water standards; domestic and industrial pollution of water; on-site water quality testing; laboratory techniques; sanitary inspections of water supplies; use of monitoring and inspection data for remedial and preventative actions; planning and implementation of water supply monitoring programmes; codes of practice for construction, operation and maintenance

Effluents and solid waste - effluent and solid waste standards; analytical techniques; monitoring the reuse of treated waste and effluent; natural water quality;

use of data to enforce compliance with standards; reuse of effluents for irrigation; planning and implementing monitoring programmes; environmental impact of effluents and solid wastes; codes of practices for construction, operation and maintenance; introduction to urban air pollution.

Building - building inspection; building quality standards; environmental hazards inside dwellings; pest control; indoor air quality; use of data to plan remedial actions; building codes of practice.

Course Structure

As this course is new and will require external inputs in its initial establishment, it is proposed to stagger the start of the pilot projects. This will have the added advantage of allowing any lessons learnt during the establishment and teaching on the first course to be used on the later pilot projects. For instance, a pilot course could be established first in Uganda, with a year later the second pilot course starting in Ghana and in the following year the course in Zambia established.

Appropriate staff in each country to teach on this course should be identified and given any further training required to meet the standard demanded of the teaching staff. Input will be required for between five and ten teaching staff for the course with a varying amount teaching required of each member of staff. Staff who are already employed by the host institution should be used wherever possible, although some staff may need to be recruited to provide certain elements of the course. An initial intake of a maximum of 20 students is suggested in the first year of each pilot course.

Each institution providing the course in the pilot scale will need to have fully equipped workshops and a reasonable budget to purchase materials and tools for the students. When the final year projects are undertaken money should also be available for the students to apply for materials where required.

As the courses progress, dissemination events should be held to share experiences of running the course, to highlight any problems and how these have been overcome and how the course model should be developed in the future. These events will enable leaders in other countries within each region to assess how successful the courses have been and how they may be adapted to suit each countries needs.

Policy Making

Introduction

The establishment of an enabling environment which positively promotes good urban environmental sanitation and encourages establishment of appropriate initiatives to improve conditions in urban areas is of great importance to the sustainability and replicability of urban sanitation projects. Central to this are: strengthening of the institutional capacity in environmental health; setting of suitable standards; establishing legislation; initiating strategic urban environmental health planning; and estimation of resources required to meet planned targets and improving the efficiency of resource use.

There is a need to further develop policy making and strategic planning for environmental health management in general and for sustainable urban sanitation in particular. Urban sanitation should become - where it is not already - a key component of national development plans.

There is commonly a perception amongst policy makers that operational staff make unreasonable demands on limited (budgetary) resources and amongst operational staff that policy makers fail to understand the importance (and therefore budget requirement) of the activities in which they are involved. In reality both are attempting to optimise the use of limited resources and there is much to be gained by increasing communication and cooperation in planning between them.

The process of strategic planning is little developed in some countries and furthermore, support for this is only likely to be effective where management (policy-makers and senior staff from operational divisions) are aware of the need for and usefulness of this approach.

It is recommended that for a limited number of countries which express interest in developing strategic planning for urban sanitation that support be provided for the development of urban diagnostic studies. This should lead on to the development of strategic urban sanitation plans which should be revised during their first two years of operation.

Project Strategy

By its nature strategic planning is a dynamic process and the specific nature of support which will be required cannot be determined in advance. The purpose of this project is not to support the development of urban sanitation *per se*, but rather to support the development of national capacity to plan effectively and efficiently for the development of sustainable urban sanitation.

Since a strategic plan is developed progressively, it is recommended that external support should be of relatively low intensity over a period of three years. During this time it is anticipated that activities within the following framework would be developed by a team comprising individuals from both policy making and operational institutions. The framework is based on that used for environmental management systems and will vary significantly in detail depending on where the work is undertaken.

- investigate, collate and summarise existing information concerning urban sanitation (coverage, cost use, effectiveness, monitoring etc);

- review information requirements for management purposes and identify information needs;

- produce an overview 'diagnostic' survey of urban sanitation (a 'state of urban sanitation' report);

- as an outcome of development of the survey, identification of research needs, monitoring requirements, priority areas and implementation targets; leading to:

- an outline five year plan with the first two years developed in detail which is revised and updated annually in advance of Ministerial budget submissions and is achievable within the prevailing conditions.

An important aim of the project would be to ensure that persons from operational and policy-making levels work together to develop an achievable and optimised plan of activity which is revised and modified on a regular (annual basis).

The development of policies toward urban environmental health conditions, including sanitation, is typically the responsibility of national and local government policy makers. However, regional (international) dialogue and exchange of experience and expertise may help governments identify appropriate strategies. To facilitate the wider dissemination of the experience obtained and especially regarding the usefulness of this type of planning it recommended that dissemination activities be built into the project framework. This may be achieved - for instance - through presentations by involved countries at a meeting of Commonwealth Ministers of Health.

Project structure

As noted previously the detailed nature of activities to be undertaken in this project will be determined in light of national conditions. It is suggested that participating countries be self-selecting.

Wherever possible the first stage of project initiation should involve the establishment of an inter-sectoral committee with responsibility for urban sanitation. This committee should have clear terms of reference and be constituted principally by policy-making and operational agencies. The constitution and role of this committee is covered in some detail in the body of this report. However it is important to note the need to ensure that the views of all interested parties including non-governmental bodies are taken into account and that advantage should be taken of other sources of expert advice.

External support provided to the project should be largely limited to an advisory role to this committee and, where appropriate to its constituent agencies.

Project outputs

Anticipated outputs in participating countries include:

- a diagnostic survey of urban sanitation;

- increased awareness of policy makers of environmental health and specifically urban sanitation issues;

- development of strategic planning for urban sanitation; which may include all or some of the following, depending on national conditions:

  - guidelines for sanitation programmes;

  - national standards and supporting legislation;

  - development of low-cost management orientated monitoring activities;

  - identification of training needs and potential solutions.

Through dissemination it is hoped that awareness of the worth of strategic planning and of the process this involves may be adopted by other African countries.

Promotion of Urban Sanitation Projects

As an adjunct to the proceeding two project proposals, individual African Commonwealth member states should prioritise the support of existing and establishment of new pilot projects which embody the principles outlined in the overview paper.

In countries where the training initiatives outlined above are proposed, it will be important that students have access to relevant urban environmental health projects, preferably projects including some sanitation upgrading.

Similarly, successful implementation of strategic planning as outlined earlier, is likely to require pilot projects for the purposes of monitoring and evaluation.

It is recommended that the Commonwealth Secretariat assist member states in attracting funding for projects of this type.

The experience and expertise gained from pilot urban environmental health projects should be as widely disseminated and promoted as possible. It is recommended that the Secretariat directly support a series of bi-annual seminars or conferences, for either a regional or continental audience to achieve this. The exchange from all countries throughout Africa may be particularly useful and allow cross-fertilisation of ideas throughout the continent.