

6th WEDC Conference : March 1980 : Water and Waste Engineering in Africa

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ASPECTS OF LOW COST SANITATION
IN AFRICAINTRODUCTION

1. Conventional sewerage is the most expensive form of sanitation and one which is unaffordable by most urban and rural communities in developing countries. In 1976 the World Bank, aware that the benefits of its lending programme in the water supply and sanitation sectors were not reaching the urban and rural poor, undertook a two year research programme into appropriate technologies for low cost water supply and sanitation in developing countries. The results of this research programme (Ref. 9) show that low cost technically viable alternative technologies to conventional sewerage do exist and that these technologies can have a public health impact similar to that of conventional sewerage.

2. Following the research programme, the United Nations Development Programme (UNDP), as part of its preparations for the International Drinking Water Supply and Sanitation Decade (1981-1990), has sponsored a global project of demonstration programmes in low cost water supply and sanitation in developing countries. Under this project, which the World Bank is executing, the Bank established a Technology Advisory Group (TAG) in late 1978 to facilitate the design, implementation and monitoring of these demonstration programmes in selected parts of the developing world.

COUNTRY WORK

3. The UNDP Global Project has so far been endorsed by 13 countries: Bangladesh, Botswana, Brazil, Egypt, India, Indonesia, Lesotho, Malaysia, Nepal, Nigeria, Philippines, Sudan and Tanzania. In this paper we present very brief summaries of aspects of TAG activities in Africa, and raise some issues of importance to sanitation programme development. The work of TAG has concentrated on sanitation programmes rather than on water supply programmes since appropriate approaches to sanitation are less well understood.

BACKGROUND

4. TAG is working on sanitation planning and development work in African countries in a wide range of social, economic, demographic and climatic situations; wide variation in some aspects is contrasted by remarkable similarities in other aspects. For example Sudan with an area of 2.5 million km² and a population of 7 persons per km² contrasted with Lesotho with an area of 30 000 km² and a population density of 43 persons per km². The countries have largely rural populations (generally over 85% rural) and a low per capita Gross National Product (GNP) of under US \$ 500 per capita.

TABLE I: LATEST ESTIMATES OF LEVELS OF SERVICE OF POTABLE WATER SUPPLY AND SANITATION IN VARIOUS COUNTRIES[†]

Country	% of Population with Safe Potable Water		% of Population with Adequate* Sanitation	
	Urban	Rural	Urban	Rural
Botswana (Ref.7)	90%	28%	30% to 50%	less than 25%
Egypt	80%	50%	n.a.	n.a.
Lesotho (Ref.7)	65%	14%	51%	3% to 17%
Nigeria	n.a.	n.a.	n.a.	n.a.
Ghana (Ref.6)	86%	14%	95%	40%
Sudan	49%	45%	less than 10% (Ref.5)	less than 30% (Ref.5)
Tanzania (Ref.2)	88%	36%	n.a.	40%

[†]Unless indicated otherwise, source is Ref. 8.

*"Adequate" is the definition used in compilation of official statistics. It does not imply that the sanitation facility is sufficient in terms of current TAG thinking.

5. Life expectancy is generally under 50 years with much of the population undernourished, and generally with poor curative and preventive medical facilities. The infant mortality rate is generally greater than 120 per thousand live births and in a few countries greater than 180 per 1 000. The human misery and sadness which this brings has a serious debilitating effect on society as well as on individual families. Between 40% and 50% of the population is under 14 years of age, with fewer than 50% at primary school; adult literacy is low (generally under 40% literate).

6. Existing service levels of safe drinking water and adequate excreta disposal are variable but not particularly good as shown in Table 1. Rural areas in particular have very poor water service levels and almost negligible excreta disposal facilities. In urban areas, service levels are highly skewed in favour of high income households who consume well above basic need levels and in many cases receive free services which the poor have either to pay for or do not receive at all.

7. The countries are all low income countries. The outlook for improvement in per capita CNP, particularly when compared with the industrialised countries such as USA or the United Kingdom, is poor, due to slow economic growth combined with high population growth. A major feature of this growth has been the trend towards increased urbanisation; this trend is projected to continue such that in sub-Saharan Africa the estimated 1975 urban population of 80 million (about 21% of total population) is expected to grow to over 250 million (about 40% of total population). The countries also have a variety of different religious, political, economic and socio-cultural environments which affect planning and implementation of sanitation programmes.

COUNTRY PROGRAMMES

8. Against the rapidly changing background described above, the need for affordable, appropriate and acceptable sanitation services will become ever more pressing. TAG work in Africa has been concentrated in Botswana, Egypt, Lesotho and Tanzania. We describe below some aspects of this work.

Botswana

9. Botswana is an arid country characterised by very low population density, a few small but rapidly growing urban areas and a cattle population of some five times the human population. Low cost sanitation developments date back to the early 1970s when Government did initial development work on glass fibre aqua privies. The prototype has various technical problems and in 1976 Government, together with the International Development and Research Centre (IDRC) of Canada, undertook an investigation into alternative forms of low cost sanitation, constructing and testing single pit Ventilated Improved Pit (VIP) latrines, Reed Odourless Earth Closets (ROECs)*, cement block aqua privies (single chamber with soakway) and composting toilets.

* A variation of a VIP with an asbestos cement seat cum chute built integrally into an offset ventilated pit.

Monitoring the long term performance of the 175 units constructed is in progress. From an initial assessment of the results, broad recommendations which related sanitation type to income level were made. It was also found in 1977 (Ref.12) that the economic cost of water-borne sewerage in Botswana was some 3 times higher than the cost of sanitation using VIP latrines and almost twice the cost of aqua privy systems. On-site systems were therefore considered appropriate for urban development.

10. The Ministry of Local Government and Lands (MLGL) is responsible for urban and rural development, and for developing sanitation as part of new infrastructure. Existing urban excreta disposal services comprise a range of systems including water-borne sewerage and septic tanks (generally for high income households), a few aqua privies with soakways (both the early prototype glass fibre model and the more recent Type B privy) as well as improved and traditional dry pit latrines. Many low income urban households (some 40% to 50% of all households) have no sanitation facilities. It has been found (Ref.9) that sitting is preferred to squatting and anal cleansing is by paper, leaves or other dry materials.

11. Government has developed extensive on-site programmes in the capital, Gaborone; a variety of VIP latrines, ROECs and Type B aqua privies have been constructed on different development projects. In the most recent project, Government is, with CIDA assistance upgrading an un-serviced low income high density housing area (plot sizes are between 400 m² and 800 m²). Sanitation is by some 450 contractor-built twin-pit emptyable VIP latrines with glass fibre sitting pans (designated the REC 11). The twin-pit design was developed in conjunction with the Building Research Establishment. (See the additional Conference paper by R E Carroll). There is one latrine per household and it is proposed that householders will complete the superstructure. Detailed site investigation was undertaken for this project and a number of prototypes constructed to establish householder preferences.

12. The twin-pit latrine has considerable advantages over a single-pit latrine; the first pit is used till full, then while put contents are biodegrading the second pit is used. If each pit is sized for at least a two year life, the pits can desludge alternately, when the pit contains a well degraded and innocuous humus⁺. Government is proposing to extend this programme. Pit emptying has yet to be undertaken and still needs rigorous investigation.

13. TAG has been working with Government on developing proposals for urban sanitation on a World Bank-assisted urban project in Francistown and Selebi Pikwe, northern Botswana, where a multi-disciplinary programme with technical assistance for self-help implementation is being considered. Government is concerned about potential environmental pollution problems associated with on-site sanitation. Some work has already been done in this area and TAG has been advising on possible future investigations.

⁺ Excreta pathogen biodegradation is well documented in Reference 9.

Government is also proposing to develop long term sanitation plans for the major villages in Botswana. These will be implemented in a phased programme over the next ten years.

14. Rural sanitation is still largely undeveloped. However, in response to a specific district level request, Government has, with USAID assistance recently started implementing a pilot rural Environmental Sanitation and Protection Programme (ESPP) on which TAG has worked. The programme will be based on the use of multi-communication media together with an action component, and will develop latrine types in response to householder preference.

15. In response to a Government proposal to promote sanitation developments, improve sector coordination, benefit from existing sector experience and develop long term plans, UNDP has agreed to fund a Public Health Engineer in MLGL. The engineer who will focus on low cost sanitation developments will take up post in April 1980, following briefing by TAG.

16. Botswana had made considerable strides towards developing sound long term sanitation strategies. A number of aspects remain unresolved but Government is committed to make progress in the sector over the next decade, bringing improved health and well-being to a small but rapidly growing population.

Egypt

17. Most urban and rural development in the Arab Republic of Egypt has taken place along the River Nile and in the Nile Delta. Rural communities have ready access to irrigation water but access to potable water of adequate quality is limited. Regional water reticulation schemes supply water intermittently; handpumps are used extensively for potable water and in many areas the water table is high; most groundwater north of 31^o latitude is saline.

18. The majority of the rural population live in small high-density communities (ezbas) to avoid using scarce agricultural land for housing. Rural sanitation, which is the responsibility of the Ministry of Health is generally poor or non-existent; the excreta disposal profile of a typical Egyptian ezba is:

- much of the population is Muslim; anal cleansing is generally with water and squatting is preferred to sitting;
- the men defecate in the mosque which has squatting plate pit latrines. The latrines are unvented, generally don't have a water seal, can be emptied through a honeycomb brick soakage pit; in some cases the pit may be offset from the squatting slab;
- a few high income houses which have water connections have septic tanks with soakaways;
- a few houses have pour flush latrines with soakaways inside the house;
- a few houses have simple pits open to the air, but partially covered by a squatting plate formed from logs, sticks and mud bricks. These latrines have no superstructure, but may have privacy walls;
- the majority of women and children use the cattleshed or yard within the household, the fields or other area with reasonable privacy.

When pits are full, they are dug out by farmers, the contents mixed with soil and organic matter, spread out to dry (in a few cases partially composted) and then applied to the fields.

19. Over the past two decades a number of rural sanitation programmes in Egypt have been unsuccessful, even though there is an extensive system of rural health clinics where staffing includes sanitarians. The sanitarians have many other duties and have consequently devoted little time and effort to sanitation. Precast concrete squat slabs and pipework for the construction of latrines with water seals are currently available but not extensively used in rural areas, probably due to shortage of finance, sound designs and technical assistance: cement shortages have in the past also considerably hampered developments.

20. TAG is working with the General Organisation for Potable Water (GOPW) and UNICEF in the design and implementation of low cost sanitation programmes in conjunction with water supply programmes in Upper and Lower Egypt. The most likely technical solution is the pour-flush latrine (PF) with twin soakage pits or the twin pit Ventilated Improved Pit (VIP) latrine. It will be necessary to line pits in many areas of high water table. Standing dirty water (such as in soakage pits) is the preferred breeding site of *Culex pipiers* mosquitoes, the vector of Bancroftian filariasis (elephantiasis). It is proposed to monitor filariasis as part of these programmes. Sullage disposal is also a problem in high-density high water table areas; proposals for sullage management will be developed as part of the programmes.

21. Many local government functions are currently being decentralised and GOPW recognise a strong need to ensure adequate sector coordination. TAG is working with GOPW in developing proposals to form a unit to assist in this coordination.

22. Urban sewerage and sanitation is the responsibility of either the national drainage authority (GOSSD) or urban and regional government. Most urban areas have waterborne sewerage systems serving portions of the population. Single chamber septic tanks* are also fairly common in both high density and high income areas; poor ground conditions and high water tables often cause clogging and flooding of septic tank effluents. Much of the urban population is not served, particularly in fringe areas; sanitation here is by using community facilities (such as mosques) or informal. Most of the waterborne sewerage systems require substantial upgrading; this together with extending many of the existing networks is now being done by Government through a number of very large programmes, which at the moment do not include sanitation.

23. Government commitment to improving excreta disposal is expected to increase due to increasing decentralisation of local government. If improved designs and financing facilities are made available it is likely that a strong private sector will develop to assist latrine construction.

* Septic tanks generally either drain to soakage pits or are left open jointed; they clog over time and act as cesspits.

Lesotho

24. TAG has been working on both urban and rural sanitation developments in Lesotho following a specific request in December 1978 from the Government of Lesotho. The Ministry of Interior is responsible for urban excreta disposal in Lesotho. There are limited waterborne sewerage systems in some urban areas (the principal urban area is the capital, Maseru which has a current population of 60 000, 5% of whom have sewerage). High income households which do not have sewerage have two chamber septic tanks with soakaways. A bucket latrine system serves some 25% of the Maseru population. The remainder of the urban population either have on-site dry pit latrines (an estimated 20%) or use open ground for excreta disposal (an estimated 40% in Maseru and rather higher elsewhere). These latrines are generally shallow unlined pits with superstructures, open to the atmosphere (i.e. without adequate cover slabs or piped ventilation), and sitting pans constructed in timber; superstructure materials vary from dressed sandstone masonry to hessian or galvanized corrugated iron.

25. Government is embarking on a number of urban upgrading and sites and services projects with assistance from CIDA and the World Bank. Sanitation will be developed on these projects as part of the infrastructure. On the CIDA assisted project in White City, Maseru, 200 single-pit emptyable VIP latrines with sittingpans are being constructed. Following extensive discussions with project beneficiaries, substructures are being built by contract labour, and superstructures completed by the householder (some of whom may prefer to employ small-scale contractors for this work).

26. As part of World Bank-assisted Maseru Urban Project on which TAG has been working with Government, a multi-disciplinary Sanitation Implementation Team will be formed in the Ministry of Interior which will assist implement urban sanitation. Following initial assessment of a range of alternative sanitation systems including waterborne sewerage, aqua privies, ROECs and composting latrines, the optimal solution for the Maseru Urban Project (in terms of affordability, technical suitability and householder acceptability) was found to be either a single-pit or twin-pit VIP latrine. A cost comparison between these two is shown in Table II.

27. It is anticipated that the sanitation for the Urban Project will comprise twin-pit emptyable VIP latrines with sitting pans; plottolders will where possible provide labour to reduce construction costs, and the technically more complex work will be undertaken through the Implementation Team. Building materials loans (received at 9% interest rate over 20 years) will be made available under the Urban Project, and the programme will include site investigation, detailed analysis of socio-cultural factors, information and health education delivery systems, training, monitoring and evaluation. Pit emptying will be undertaken approximately every 4 years by the Municipal Council; emptying methods and institutions will be developed through the Urban Project. This urban programme is the first phase of planned long term improvements in urban sanitation; Government is developing a phased long term sanitation plan for all urban areas in Lesotho.

28. Service levels of rural excreta disposal in Lesotho are low; where latrines exist they are generally squatting type unimproved dry pit latrines.

TABLE II COST COMPARISON OF SINGLE vs TWIN-PIT LATRINE (JANUARY 1980 PRICES)

	Substructure Construction \$US	Net Present Value of ² emptying costs \$US	Total \$US	Monthly Charge ³ to Householder \$US
Single Pit	162.5	61.3	223.8	2.03
Twin Pit	218.8	8.8	227.6	2.05

On health and institutional grounds the twin-pit is preferable and only marginally more expensive

1. Anal cleansing is with paper, leaves, grass or other dry materials; water is not generally used in Lesotho.
2. The twin pit will need far less frequent emptying and negligible sludge treatment compared to the single pit during the 20 year period considered.
3. Loan recovered at 9% interest rate over 20 years.

Government is about to approve and start implementation of a long term phased sanitation programme developed with TAG which will complement the rural water programme. Development will initially take place on a small scale in a number of villages which have either on-going rural development or rural health worker programmes. Latrines will probably be twin-pit VIP latrines. The programme will include training, monitoring and evaluation, and strengthening the Ministry of Health in health education, epidemiology and socio-cultural aspects of sanitation programme development.

29. TAG is working with Government on the development of other activities in the sector such that the long term development needs of sanitation and water supply programmes in both urban and rural sectors will be clearly identified. Of major concern to Government is the current shortage of trained manpower; considerable attention is being focussed on this issue.

30. Government commitment to the sector is high, and if manpower and financial constraints can be overcome substantial progress will be made in Lesotho over the next decade.

Tanzania

31. The Government of the United Republic of Tanzania is fully committed to the provision of safe excreta disposal facilities for both urban and rural populations by the development of long term sanitation programmes. Rural excreta disposal is the responsibility of the Ministry of Health (AFYA). The need for improved excreta disposal in Tanzania is substantial. A recent survey of 10 rural districts found that 39% of houses surveyed had "satisfactory pit latrines" (over 6 feet deep, good walls, proper door, good squatting slab), 25% had unsatisfactory pit latrines, while 36% had no latrines. The proportion of houses in different districts having a satisfactory pit latrine ranged from 75% to 1% indicating an enormous variation in sanitary conditions. Rural latrines are constructed by householders, mainly by putting logs over an excavated pit to form a squatting slab; traditional materials are used for constructing the superstructure. Health officers (Bwana Afya) in AFYA have many duties and are unable to devote much time to sanitation.

32. TAG has been working with the Government of Tanzania to promote the sanitation sector since November 1978, and is advising AFYA on rural sanitation. AFYA has formed a Rural Sanitation Unit (RSU) with a staff of three experienced health officers. It is envisaged that rural sanitation projects will develop in conjunction with a number of on-going or planned rural water projects.

33. Urban excreta disposal is the responsibility of the Ministry of Lands, Housing and Urban Development (ARDHI). A few urban areas have limited sewerage systems; however the majority of the urban population (which is 12% of total population) have pit latrines.

A recent survey (Ref.7) of the capital, Dar es Salaam, found that 76% of households had pit latrines, 12% waterborne sewerage, 10% septic tanks and only 2% were unserved. With the support of TAG, ARDHI has created a Low Cost Sanitation Unit (LCSU) to plan and coordinate urban excreta disposal programmes. The LCSU at present comprises a Tanzanian civil engineer, an expatriate civil engineer, two health officers and a technician. ARDHI has commissioned consultants to prepare master plans for sanitation and sewerage in Arusha, Dar es Salaam, Morogoro, Moshi and Mwanza. TAG is working with ARDHI on these projects.

34. It is concluded that the strong commitment of the Tanzanian Government to low cost sanitation is likely to ensure considerable progress in providing adequate excreta disposal facilities for both urban and rural populations over the next decade.

ISSUES OF NOTE

35. The country work described above has raised a number of issues most of which are as yet unresolved; it has also enabled some broad conclusions to be drawn for future work.

Manpower development and training

36. Sound manpower development and training programmes have long been recognised as crucial for economic growth and development in developing countries. Low cost sanitation developments in the countries discussed are still in the formative stages; training and information dissemination is therefore essential at all levels. Decision makers, planners and engineers need orientation, technicians and operators need to be trained and householders need to be informed. TAG work with Governments in programme design has specifically integrated manpower development and training at all levels into programme design; the impact of this on project costs is substantial however and could often best be borne by central government.

Self-Help

37. "Self-help"* which (together with "community participation") has tended to become the development planner's surrogate for sound programme design has a major role in sanitation programme development. The two major objectives of self-help are:

- to reduce system costs by having the householder undertake part of system construction, operation and maintenance; and
- to achieve householder commitment through involvement, thereby improving the chances of adequate system usage and maintenance, thereby realising investment benefits.

* Self-help inputs to sanitation programmes in the context of this paper are defined as inputs by beneficiaries in the form of householder labour and materials in the construction operation and maintenance phases.

38. A number of self-help orientated sanitation programmes in Africa have experienced implementation problems principally due to insufficient technical support thereby stretching householders beyond their capability. In these situations the waste of resources and squandering of householder goodwill will have a long-term detrimental impact on sector development. In many African countries the traditional method of trying to improve low cost sanitation has been for the Health Ministry to verbally exhort householders to build latrines; in a few countries, sketches are provided (generally very poorly 'engineered' structures) after which the householder is left to his own devices with no access to technical backing, materials purchasing or financing. Latrines, when built, often collapse; in some cases children fall into the pits.

39. What is needed in reality is sound, well-illustrated designs (bearing in mind adult literacy rates) preferably modelled in 3 dimensions, together with access to building materials, tools, low level technical assistance, finance and supervision. The level of input required will clearly vary in each country and programme. It is crucial to successful programme development that self-help is not stretched beyond its capability, and that the correct level of resource support is provided to assist participants.

Socio-cultural aspects of sanitation

40. A sound understanding of socio-cultural aspects of sanitation at community, household and individual level is essential to ensure effective programme design and subsequent successful implementation. TAG has been working in the countries in multi-disciplinary teams. All programme design work has proposed socio-cultural inputs throughout project life to enable sound implementation.

Communal Facilities

41. Consideration has been given in many African countries over the years to the construction of communal or shared facilities. With the exception of the well documented and unique "Comfort Stations" programme in Abadan, Nigeria, communal facilities have either been a failure or have been rejected by the community. However since community facilities are substantially more cost effective than individual household facilities, it is felt that their development should be explored further in African programmes, such as programmes in which each household has a private room which it maintains.

Beneficiary Oriented Information Systems

42. Crucial to success of sanitation programmes is the development of beneficiary and community oriented information systems. It is generally agreed that health education is an essential complementary input to water and sanitation investments; however TAG work in a number of countries is now being orientated to the development of more broad-based information systems which will include health education and will:

- introduce the sanitation programme to the community
- stimulate interest and encourage participation
- provide technical information and identify benefits
- identify financing mechanisms and sources of materials
- promote continuing facility use by all the family.

A range of communication media are available for this including radio, cassette tapes, pamphlets and posters. Urban authorities, and "hardware" oriented authorities (Ministries of Works) have limited experience in this area; sanitation project design in future will need to strengthen these functions.

Latrine Emptying

43. Latrine emptying remains an unresolved problem in Africa. There is no recent experience of emptying well engineered latrines and the recently developed twin pit latrines have yet to complete a life cycle. There is a marked reluctance in Africa to handle excreta (fully decomposed or otherwise) and in investigations done in the IDRC Research Project into the acceptability of alternate sanitation systems, composting was rejected as being unacceptable due mainly to a reluctance to handle fresh or decomposed excreta.

44. In both urban and rural areas, latrines are currently moved when they are full; this is clearly uneconomic when they are well built, and also unacceptable to householders who have put substantial effort and finance into latrine construction. As urban plot sizes reduce* it becomes both technically difficult and expensive to reexcavate pits and move superstructures. The development of twin-pit latrines will overcome the problem. The BRE (UK) is planning to evaluate pit emptying methods in Botswana, and TAG is planning to investigate this elsewhere; this work is crucial to the development of low cost sanitation.

Environmental Pollution Hazards

45. Extensive improvements of service levels of water supply and sanitation in developing countries can only be undertaken if groundwater sources are substantially developed and low cost on-site systems of excreta disposal adopted. These two strategies are in conflict in that on-site excreta disposal will in many circumstances pollute groundwater sources. Insufficient is known at present about these potential hazards in developing countries, and consideration is being given in a number of countries (in particular Botswana and Egypt) to assessing the impact of on-site systems on the environment in general and groundwater in particular.

* Site and service plots sizes in low income urban Africa have reduced from over 1 000 sq m in the early 1970's to currently under 200 sq m.

The recent improvements in membrane filtration techniques (making them simple, inexpensive, reliable and rugged) together with more reliable methods of sampling (such as the Water Research Centre UK in-situ sampling device) has meant that the rigorous monitoring programmes needed can be relatively easily undertaken. TAG is working with various governments in addressing this issue.

Cost Recovery

46. Policy and mechanisms for effective administration of sanitation cost recovery are in the formative stages in many of the countries in which TAG is working. A common decision criteria has been that the monthly household financial cost of water supply and sanitation services should not exceed 5% of monthly household income. Low cost sanitation projects aim to deliver services to the rural and urban poor and by implication are aimed at households near or often below the poverty threshold; cost recovery policies for this population group are intrinsically difficult to develop and administer.

47. There is little point in developing a cost recovery policy which requires effective institutions for implementation if these institutions do not exist; in countries in which TAG is working therefore, institution strengthening is considered a major project objective concurrent with the development of cost recovery policies.

TYPICAL PROGRAMME DESIGN

48. From the work undertaken in the various countries, and experience to date in the sector it is concluded that a general structure for sanitation programme development should include the following key elements:

- a central sanitation steering committee comprising the ministries or departments responsible for finance and planning, health, urban and rural development, water supply and sewerage;
- sound project management, technical assistance and site investigations;
- preinvestment assessment of socio-cultural factors, and beneficiary sanitation preference;
- information systems development and community dialogue;
- access to and delivery of building materials and mass produced components, combined with financing mechanisms;
- integration of sanitation designs with related physical infrastructure development (particularly water supply, storm water drainage, and housing layouts);
- integration of sanitation programme management with existing administrative structures (such as town councils);
- monitoring and evaluation programme;
- a programme for briefing central government personnel, and training engineers, technicians, artisans and extension workers.

A number of proposed programmes designed by governments with TAG inputs in Botswana, Egypt, Lesotho and Tanzania will be developed along these lines.

CONCLUSION

49. While the need for improved sanitation in much of Africa is substantial, the Governments in countries in which TAG is working have shown a commitment to develop programmes to meet these needs. Although developments are still in the formative stage, institutional structures and technical options are emerging which it is anticipated will prove successful. Crucial to success in this new area of development will be high government commitment combined with sound planning, sensitive implementation and considerable support by multilateral and bilateral agencies. These efforts will produce effective programmes only if sustained householder commitment to programme development is achieved by culturally responsive design and implementation.

Acknowledgements

The authors would like to express their thanks to the many Government officials in the countries in which TAG has worked for their assistance and for much of the information contained in this paper. The views expressed however are those of the authors alone as are the omissions.

REFERENCES

1. WORLD BANK, "1979 World Bank Atlas", World Bank, 1979, 23 pp.
2. WORLD BANK, "World Development Indicators", World Bank, June 1979, 51 pp.
3. WORLD BANK, "World Development Report, 1979", World Bank, August 1979, 188 pp.
4. WORLD BANK, "World Atlas of the Child", World Bank, 1979, 39 pp.
5. AGIB, A.R.A., "Some aspects of Sanitation in the Sudan", Proceedings of Cairo International Regional Seminar on Sanitary Engineering, May 1979, 30 pp.
6. WORLD WATER, "International Drinking Water and Sanitation Decade '80siers' ", December 1978, July 1979, August 1979.
7. WORLD BANK, "UNDP Global Project GLO/78/006 Technology Advisory Group International Country Reports", various reports from November 1978 to January 1980 inclusive.
8. WORLD HEALTH ORGANISATION, "World Statistics Report", WHO, Vol. 29, No. 10, 1976, pp 543-603.
9. WORLD BANK, "Low Cost Sanitation Research Project Reports", Volumes I to VI inclusive; RES 22; Drafts, October 1978.
10. WORLD HEALTH ORGANISATION, "Sodium, Chlorides and Conductivity in Drinking Water", WHO ENRO Reports and Studies 2, WHO, 1979, 63 pp.
11. LEWIS, W.J., FARR, J.L. & FOSTER, S.S.D., "A Detailed Evaluation of the Pollution Hazard to Village Water-Supply Boreholes in Eastern Botswana", G.S.10, Department of Geological Survey, Botswana, June 1978.
12. WORLD BANK, Internal Memorandum S.E. Daher, December 1977.