Drawers of Water II

30 years of change in domestic water use & environmental health in east africa

Uganda country study

by **Dr James K Tumwine**

series editor **John Thompson**

DFID Department for International Development · Sida · Ministerie van Buitenlandse Zaken

Credits

International Institute for Environment and Development
3 Endsleigh Street, London WC1H ODD, United Kingdom

Designed by Pat Porter, Design and Publishing Ltd. Printed by Russell Press, Nottingham.

ISBN 1 904035 01 9 9082IIED Uganda

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Glossary

CAO Chief Administrative Officer
CPAR Canadian Physicians for Aid and Relief
DANIDA Danish Aid Agency
DAPCB Departed Asians Custodian Board
DFID Department for International Development
DGIS Ministry of Foreign Affairs, The Netherlands
DOW Drawers of Water
DOW I Original Drawers of Water study by White, Bradley & White
DOW II Repeat Drawers of Water study
ECWSP Eastern Centres Water and Sanitation Project
FA Field Assistant
FGD Focus Group Discussion
GDP Gross Domestic Product
IDA International Development Agency
IIED International Institute for Environment and Development
IMF International Monetary Fund
LC Local Council
LWF Lutheran World Federation
MFEP Ministry of Finance and Economic Planning
NGO Non Governmental Organisation
NWSC National Water and Sewerage Corporation
PLA Participatory Learning and Action
PRA Participatory Rural Appraisal
RDC Resident District Commissioner
RUWASA Rural Water and Sanitation
Sida Swedish International Development Cooperation Agency
SRO Senior Research Officer
STWP Small Towns Water and Sanitation Project
TTC Teacher Training College
UN United Nations
UNICEF United Nations Children Education Fund
USA United States of America
WHO World Health Organisation

Preface

Back in the 1960s there seemed few facts available about water supply in Africa and almost none from the users' standpoint. There were no set ways to investigate the questions, nor was it clear what the key questions were. A geographer and a sociologist, keen to investigate household decision making over water, were introduced to a medical researcher with a Land Rover and this led to a detailed survey of 20 or so households in each of 34 communities to get a first cut at answers to an array of questions about domestic water use in the three countries of East Africa: Kenya, Tanzania and Uganda.

The findings of this research eventually were published in several journal articles and in the book *Drawers of Water: Domestic Water Use in East Africa*. Some of the results were unexpected, but their main value was to open up an area for future research and policy formulation. Subsequent work has been more focused and detailed in addressing specific questions but the broad picture has not been lost. Domestic water, even in rural areas, became for over a decade an increased focus of attention, and governments claimed to be making many improvements.

Against this background, Dr James Tumwine of Makerere Medical School, Uganda, along with his colleagues Dr John Thompson of the International Institute for Environment and Development, London, Professor Mark Mujwahuzi of the Institute of Resource Assessment at the University of Dar es Salaam, and Dr Munguti Katui-Katua of Community Management and Training Services, Kenya, sought to carry out a follow-up study nearly three decades later. It required much perseverance as funding agencies were initially not keen, but eventually with a dedicated group of young and able field assistants,

a 30-year follow-up was achieved, replicating the methodology and sites of the original work.

The results are beginning to appear, and it is possible to see the diversity of changes that have occurred. Some are sobering – improvements have not occurred in some areas – and others were unanticipated. That a simple change in technology, from the '*debe*' to the plastic can, has affected the gender distribution of water-carrying by enabling men to carry water on a bicycle and thereby avoid the ridicule that would have been the consequence of a *debe* as head-load, was unexpected.

The rarity of long-term longitudinal studies is well known, and this unique 30-year follow up of the same sites will contribute a wealth of new knowledge to water supply and use for developing countries. Moreover it provides a tool for further research on the process of change. It is possible now to select communities where the changes are dramatic and to focus the search for explanations of process on these. The question 'why?' rather than simply 'how much?' is now being addressed, and *Drawers of Water II* will surely stimulate both interest in domestic water use and a much richer level of understanding and explanation of what we originally referred to as one of mankind's most basic transactions with nature.

Gilbert F White and David J Bradley
Boulder and London 2002

Acknowledgements

I am very grateful to Dr John Thompson of the International Institute for Environment and Development (IIED), London, the principal investigator and main architect of this project, whose interest in water dates back to the time he served as a volunteer water technician in remote areas of Kenya and Tanzania some two decades ago. John is a modest, but resolute intellectual who is an advocate of participatory methods in research and development. I cannot find words with which to thank him for providing the Uganda team with the opportunity to revisit the *Drawers of Water* study.

We were fortunate to get invaluable advice and encouragement from Professors Gilbert White and David Bradley, two of the three principal investigators in the original Drawers of Water study. To Gilbert and David, we say thank you very much.

In Uganda, I gratefully acknowledge Adoniya Kyeyune, John Wavamunno, Jane Ssozi and Ben Osuga of the Uganda Community-Based Health Care Association for providing crucial technical advice and logistic support during the fieldwork. Nelson Sewankambo, Dean of the Makerere Medical School, offered moral support and institutional backing. John Baptist Lwanga of the Child Health and Development Centre, Francis R Mugisha of the Makerere Institute of Statistics and Applied Economics, Albert Maganda of Makerere Medical School/Case Western University Research Collaboration assisted with data entry and analysis.

The field assistants Ronald Byandala, William Eriaku, Robert Kakaire, Angela Georgina Manyuru, Andrew Kizito Muganga, Eva Nangobi, John Bosco Okullo, and Nelson Turyahabwe, and to

medical students, Abdhalah Ziraba and Miriam Nakalembe, put long hours of painstaking and meticulous work into the project. Their commitment, good humour and professionalism throughout the entire process helped us achieve our ambitious research objectives.

In the UK, Ina T Porras of the International Institute for Environment and Development, London, made considerable contributions to the report, both in terms of data analysis and presentation and editing and final layout. Her input during key stages of the report writing was invaluable. Nick Johnstone and Libby Wood of IIED also ably assisted the research team from statistical training through to data analysis and write up.

We also thank Mrs Nsubuga and Agnes Nabalamba for secretarial assistance in Uganda. In UK, we thank Pat Porter for her creative design work and help in preparing the final layout of this report.

Several other individuals deserve special mention, especially our research partners Professor Mark R Mujwahuzi of the University of Dar es Salaam, Tanzania, and Dr Munguti Katui-Katua of Community Management and Training Services, Ltd. (EA), Kenya. We would also like to gratefully acknowledge the advice and assistance of Professor Sandy Cairncross and Kathryn Jones of the London School of Hygiene and Tropical Medicine, Dr Eliab Some of the African Medical and Research Foundation, Kenya, Patrick Kahangire of the Directorate of Water Development, Uganda, Professor Muzaale of the Public Service Commission, Uganda, Dr Jan Olof Drangert of Linköping University, Sweden, and Mr Hans van Damme, Special Adviser to the UN Collaborative Council for Water Supply and Sanitation. Finally, we would like to thank colleagues in the Department of Paediatrics and Child Health, the National Environment Management Authority library staff, the District Directors of Health, Population Officers, Meteorological Officers, the Uganda National Council of Science and Technology, and the National Water and Sewerage Corporation.

To the women, men and children in the study sites who gave us their time and valuable information, assisting us to get a glimpse of water use and environmental health in their homes, we are very grateful.

I would also like to offer special thanks to Lynnette Tumwine for her great patience, understanding and support.

This work would not have been possible without the generous assistance of the Department for International Development (DFID) of the United Kingdom, the Ministry of Foreign Affairs (DGIS) of The Netherlands, the Swedish International Development Cooperation Agency (Sida) Sweden, and The Rockefeller Foundation's Regional Office for Eastern and Southern Africa. At these agencies, I would like to make special mention of Ingvar Anderson and Margaretha Sundgren (Sida), Willem Ankersmit (DGIS), and Ian Curtis (DFID) for their unwavering support of this initiative.

The ideas expressed in this report are those of the author and do not reflect the views of any other person or organisation. Any errors or omissions in this report are my responsibility.

James K Tumwine
Kampala 2002

Executive Summary

This interdisciplinary and multi-institutional project has emerged out of a growing recognition of the general lack of quality information and knowledge of the long-term trends and impacts of domestic water and environmental health policies and interventions on local people's well being. This is particularly the case in Africa, where knowledge of household water supply and productivity is limited to a handful of original studies, which continue to be cited and recycled in the literature. Foremost among these is *Drawers of Water: Domestic Water Use in East Africa*, by Gilbert F White, David J Bradley and Anne U White, published in 1972 by The University of Chicago Press. That study reported the results of a data collection effort spanning 34 communities in Kenya, Tanzania and Uganda in the late 1960s. Given the quality and breadth of its analysis, *Drawers of Water* (DOW I) remains one of the most comprehensive and compelling accounts available on water use in Africa.

In 1997, nearly three decades after White, Bradley and White published their landmark study, a team of African, European and North American scientists returned to the original *Drawers of Water* research sites in Kenya, Tanzania and Uganda to assess key trends and changes in domestic water use and environmental health. This work, referred to below as *'Drawers of Water II'* or *'DOW II'*, involved more than 1,000 sample households and two phases of intensive survey and participatory research. In addition, the original *Drawers of Water* dataset was carefully checked and recomputerised to allow for a full multivariate statistical comparison of the water/health situation in the late 1960s versus the late 1990s.

This paper reports the initial results of the study in the 11 *Drawers of Water* research sites in Uganda and provides a comparison of the two datasets spanning 30 years of change. It also introduces findings from a second phase of participatory research, which provides insights into the water use histories of selected sites. The analysis shows that while significant progress has been made in improving the water and environmental health situation in some places and for some people in Uganda over the past three decades, elsewhere conditions have gone from bad to worse.

Objectives and Study Design

The major objective of the first phase of this study was to carry out a comprehensive repeat cross-sectional analysis of domestic water use and environmental health in East Africa based on DOW I. It also aimed at assessing the changes and impacts of domestic water use and environmental health in the research sites originally studied by the authors of DOW I and establishing the intra- and inter-community variations and determinants of domestic water use.

The objective of the second phase of the project was to reconstruct the history of domestic water use and environmental health systems and services in selected sites, while examining the roles of local and external actors and the effect of national policies and programmes. The ultimate aim was to inform and influence national and international debates on water, health, poverty and policy, through a series of workshops and publications.

Methodology

The country-level research in Uganda was carried out in the same research sites studied in DOW I. The sites give a diverse range of physical and social settings and characteristics including agroecology, altitude, climate, population density, and water infrastructure. Of the sites, four were classified as rural (Mwisi, Alemi, Kasangati and Iganga), while seven were urban (two in Iganga, two in Tororo, two in Kamuli and one in Mulago, Kampala).

Field assistants spent at least one full day with each sample

household carrying out observations and conducting semi- structural interviews. In addition, they measured the slope and distance to water sources, weighed the amount of water carried to the home and noted the people carrying it, calculated the amount of energy (calories) expended in water collection, and observed and recorded the amount of water used in the home. They also collected information on household socio-economic characteristics, prevalence of diarrhoea, state and use of latrines, sources of water and conditions of use.

For unpiped households, reported water use was checked by interviewing members of the household and observing the actual number of trips to the water sources, whenever possible. In the piped sites, readings for a full year were obtained (where available) from the local water or town council office of each of the houses and similar observations made for the unpiped sites.

During the second phase, participatory appraisal methods were used in four sites to involve local people in the analysis of key trends and changes in their water use histories. These methods, including focus group discussions, semi-structured interviews, resource maps, matrix scoring, pair-wise ranking, time lines, pie charts, Venn diagrams, transect walks, daily activity diagrams (daily routine), key informant interviews, seasonal calendars, cause-effect diagrams, flow diagrams and mini case studies, allowed the researchers and local participants to critically examine the activities and interactions of internal and external organisations and institutions that influenced water development in their communities.

Results

In Uganda, 378 households were studied in detail, of which 260 were 'unpiped' (i.e., those where water was carried to the home from an external source) and 118 were 'piped' (i.e., those where water was piped into the home and was available more than six months per year).

Mean daily per capita water use. For the unpiped households, mean per capita water use ranged from a low of 9.1 litres in Mwisi in the

Kigezi mountains in South West Uganda to 25.4 litres in Kamuli, 60 km north of the source of the River Nile.

For the piped households, mean per capita water use ranged from 16.4 litres in Iganga to 110.7 litres in Tororo low-density area. The majority of piped households were found in Tororo, Mulago and Kamuli. Almost all those households in Iganga, which in 1967 received piped water, had become 'unpiped' by 1997 because of near collapse of the piped water system in the town.

Changes in per capita water use in unpiped and piped households, 1967 to 1997. Overall, mean per capita water use in the unpiped households has improved from 12.3 litres in 1967 to 18.3 litres in 1997. For the piped households, there has been a general decline in mean per capita water use from 108.3 litres in 1967 to 58.5 litres in 1997. Despite this decline, per capita water use in piped urban households is still 2.4 times higher than for unpiped households in rural areas.

Water use activities. The activities that consumed the most water in the piped households in the current study were toilet flushing, bathing and washing, while for the unpiped households bathing and washing were the leading water use activities.

Determinants of per capita water use. For unpiped households, factors with a statistically significant positive association with per capita water use include: urban location, proportion of females in the household, household head is a business person, equipment index, distance to source (return journey), and household using water for livestock ($p<0.05$.)

However the number of people in the household, proportion of children, and use of rainwater during the year showed a significant negative association with log per capita water use ($p<0.01$).

Amongst piped households, only the number of people in the household and use of water for gardening and for livestock had significant effect on the log of per capita water use ($p<0.05$).

Drawers of water. As in DOW I, the main drawers of water are female adults and children with males doing very little carrying.

The reasons for lack of change in this area over the three decades include the perpetuation of cultural practices and gender roles, and some social conservatism on the part of some men and women.[1] Porters and vendors play a marginal role in water delivery, accounting for only 8.5 percent of all the drawers for unpiped households. Most water vendors are young men or male teenagers located in urban or peri-urban areas, although a few women are employed by water committees or owners of private boreholes or kiosks to sell water.

Range of choice. The average number of water sources has increased from 1.7 in DOW I to 3.2 in 1997. Most of the households draw their water from springs (42 percent), hand pumped wells (26 percent) or stand pipes (12 percent). Only 42 percent of the sources used by unpiped households can be considered 'safe.'

Technological factors. The 15-19-litre *debe* observed in 59.4 percent of the 166 households in DOW I has disappeared from use. It has been replaced by the plastic 20-24-litre jerry can in 91.2 percent of the 238 sample households studied in DOW II.

The vast majority (83 percent) of the drawers of water walk to the water sources while only a handful use bicycles (11 percent) or hand drawn carts.

Water storage. Overall the number of households storing water both in the piped and unpiped households has increased. While only one (1.2 percent) of the sample piped households in the late 1960s was storing water, 86.6 percent of the piped households were storing water three decades later - a dramatic increase. This appears to be a response to the growing unreliability of supply and time pressure on family labour. Similarly, the proportion of unpiped households storing water has increased from 46.7 percent in 1967 to 85 percent in 1997.

1 For a broader discussion on these issues, see Brismar, A. 1997. Fresh Water and Gender, A Policy Statement. Comprehensive assessment of the fresh resources of the world. Stockholm Environment Institute, and Thomas, H., J. Schalkwyk J, and B. Woroniuk 1997. A Gender Perspective in the Water Resources Management Sector Department of Natural Resources and Environment. Swedish International Development Cooperation Agency: Stockholm.

Water supply services. Whereas the supply in Tororo town was satisfactory with a reliable 24-hour service, the situation in Iganga town was different with the supply available for an average of only four hours (two hours in the morning and two hours in the evening.)

Institutional factors. There has been considerable investment in the water sector by donors and government, although this has not managed to keep pace with the rapid population growth. Some areas such as Iganga and Alemi have only had marginal public investment, and water supply in these two areas remains precarious.

The political turmoil and subsequent insurgency and counterinsurgency wars in northern Uganda have not been conducive for investment in the water sector. People in Alemi felt generally marginalised by both local and central government and were frustrated by what they considered to be a bureaucratic and 'corrupt' system.

The expulsion of the Ugandan Asians and declaration of the so-called economic war by dictator Idi Amin in 1972, led to anarchy and re-allocation of houses and property owned by the Asians to indigenous Ugandans especially in Iganga town. Most people who were allocated these properties never repaired or maintained them, and the buildings, toilets and water supply systems were found to be in a poor condition during the DOW II study.

In response to the deteriorating water situation in Iganga town, the private sector has come in to fill the gap. Water selling takes place at kiosks and boreholes, where people come to collect their supplies, and via water vendors, who deliver it to the door. The private boreholes in Iganga were constructed for a fee of 7-10 million Uganda Shillings, a substantial investment by Ugandan standards. In Tororo, Senior Quarters private investment in the water sector is minimal given the considerable investment in the sector by government and international financial institutions.

Civil society and other groups. The Rural Water and Sanitation (RUWASA) project, the Government of Uganda, the Danish

International Development Agency (DANIDA), several NGOs and local communities have collaborated in Eastern Uganda districts to improve water and sanitation services. Current emphasis is on privatisation of water services and preparing and supporting districts to take over management of their water supplies.

Sanitation, hygiene behaviour and diarrhoea. During the two study periods the prevalence of diarrhoea has remained consistently higher in the unpiped sites (24 percent in 1967 and 26.2 percent in 1997) than in the piped sites (2.4 percent in 1967 and 10.1 percent in 1997).

The prevalence of diarrhoea was highest in Alemi during both DOW I and II, where 62.2 percent and 80 percent of the sample households respectively had experienced at least one case of diarrhoea during the week preceding the survey respectively.

Latrine possession had an important influence on prevalence of diarrhoea in the DOW II study (this was not studied in DOW I). The proportion of households with at least one diarrhoea case was greater for those households without a latrine (46.3 percent) relative to those households with a latrine (16 percent).

Status and use of latrines. Piped households (94 percent) were more likely to have latrines than unpiped households (71.9 percent) ($p<0.01$). However there was no statistically significant difference in latrine possession between rural (74.1 percent) and urban (80.8 percent) areas ($p=0.15$).

The commonest type of latrine in the unpiped households was the pit (80.7 percent) while in the piped households it was the flush toilet (68.1 percent). Surprisingly, the commonest latrine type in the urban households was the pit (49.6 percent) and not the flush toilet (33.3 percent). As expected the pit was the commonest type of latrine in the rural households (90.3 percent).

Of the 218 latrines in the unpiped households 31.2 percent had faecal matter on the floor compared to only 7.3 percent of the latrines in the

118 piped households ($p<0.01$). Similarly 32 percent of the 100 latrines in the rural households had faecal matter on the floor compared to 19.1 percent of the 236 latrines in the urban households ($p<0.05$). Whereas nine percent of the latrines in the unpiped households had faecal matter in the surroundings only 0.8 percent of the latrines in piped households had faecal matter in the surroundings.

However 8.4 percent of the latrines in the urban areas had contaminated surroundings compared to only 1.0 percent in the rural areas despite having clean floors. Most (98.9 percent) of the piped households disposed of their children's faeces safely (toilet, bucket) while only 9.4 percent of the unpiped households disposed of the children's faeces safely (toilet, bury in soil).

The prevalence of diarrhoea has gone up since DOW I and seems to be influenced by latrine possession, hygiene, structure and education level.

Conclusions

- Mean per capita water use in the unpiped households has marginally improved from 12.3 litres in 1967 to 18.3 litres in 1997, while that in the piped households has declined from 108.3 to 58.5 litres.

- Despite the decline, per capita water use in the piped households is still 2.4 times more than that in the unpiped households.

- The most intensive water use activities in the piped households are toilet flushing, bathing and washing. In the unpiped households bathing and washing are the most water intense activities.

- Per capita water use for drinking or cooking is almost the same for piped and unpiped households.

- Socioeconomic factors having a positive effect on per capita water use in the unpiped households include: urban location, proportion of females in the household, household head is a business person, equipment index, and using water for livestock.

- Factors having a significant negative effect on per capita water use include number of people in the household, the proportion of children, and use of rain during the year.

- The main drawers of water are women and children, with porters and vendors playing a marginal role.

- The range of choice (average number of water sources) has increased from 1.7 to 3.2 in unpiped households.

- However only 42 percent of the water sources used by unpiped households can be considered safe.

- The majority of the households draw their water supplies from unprotected springs, wells with handpumps, or standpipes.

- The *debe* observed in almost 60 percent of households in DOW I is now extinct and has been replaced by the ubiquitous plastic jerrycan (91.2 percent).

- The vast majority (83 percent) of the drawers of water walk to the water source with only a handful using bicycles (11 percent) or hand drawn carts (four percent).

Key Issues and Recommendations

1. **Changes in domestic water use**
   There has been a significant decline (50 percent) in per capita water use especially in the piped households. While the mean daily per capita water use has almost doubled in the unpiped households, the level is still below the recommended 20 litres per capita per day.

   There is need to reverse the trend by increased investment in the water sector in the rural and urban areas.

2. **Determinants of water use**
   In both unpiped and piped households the main determinants of

per capita water use are the household's 'wealth' and cost of water. Piped households still pay much less than households obtaining water from vendors.

There is need to initiate policies and projects to improve the economic well being of the households and to review the overall pricing of water in order to address the needs of the poor.

3. **Deterioration of pipe water systems**
Most of the piped systems have experienced a significant deterioration mainly because of the stress of increasing urban population, and lack of system maintenance and investment.

In order to halt the deterioration, there is need for innovative approaches to investment financing and capacity building of private and public and local consumer's groups.

4. **Burden of water collection**
The burden of water collection is still borne by women and children. This is aggravated by long waiting times at the source and labour intensive methods of carrying water.

There is a clear need to alleviate this burden by improving economic and general well being of women and children enabling them to participate in household and community decision making process.

5. **Health and hygiene**
Diarrhoea and other water-related diseases are still a problem. Unsafe water sources, poor sanitation and unhygienic practices increase the rate of diarrhoea.

There is a clear and pressing need to increase levels of investment in water and sanitation facilities. These must be accompanied by hygiene programmes to maximise health benefits.

1 Introduction and Background

1.1 Background

This report highlights our basic impressions of domestic water use and environmental health in 11 rural and urban study sites in Uganda. In particular, we document initial qualitative and quantitative information about changes in water use, cost, socio-economic, environmental, technological and environmental health issues. The issues of domestic water use and environmental health in Uganda are inextricably linked with the post independence history of conflict, wars, economic mismanagement, and political instability.

Since the publication of *Drawers of Water I* (DOW I), there has been a flurry of activity in the water sector including the International Drinking Water Supply and Sanitation Decade in the 1980's, the Fresh Water Initiative of the UN Commission on Sustainable Development, activities by the Global Water Partnership and others. In sub-Saharan Africa, there are only a handful of published studies of domestic water use based on direct observations or other reliable research methods (Cairncross and Cliff,1987; Esrey, Habicht and Casella, 1992).[2] Generally, there is a dearth of quality information on domestic water use, and factors influencing water use. Consequently the design and implementation of equitable, effective and viable water and environmental health programmes and policies, has remained largely problematic.

The aim of the current study was to chart major changes and trends that have occurred in domestic water use and environmental health in the 34 sites covered by the authors of DOW I, White, Bradley and White (1972).

2 Cairncross, S. and J.L. Cliff. 1987. Water Use and Health in Mueda, Mozambique. Transactions of the Royal Society of Tropical Medicine and Hygiene 81: 51-54. Esrey, S.A., J. Habicht and G. Casella. 1992. The Complementary Effect of Latrines Increased Water Usage on Growth of Infants in Rural Lesotho. American Journal of Epidemiology 135(6): 659-66.

1.2 Objectives and Activities

The major objectives of this research were to:

- carry out a comprehensive repeat cross-sectional analysis of domestic water use and environmental health in Uganda based on DOW I;
- reconstruct the history of domestic water use and environmental health changes and impacts in selected research sites;
- assess the intra-household, intra-community and inter-community variations in domestic water use related to investments in water supply and environmental health systems and services;
- examine the roles of local and external factors, policies and programmes;
- through these findings to inform and influence national and international debates on water, health, poverty and policy via a series of workshops and formal and informal publications; and,
- outline a strategy for selecting several representative DOW field-sites for long-term monitoring.

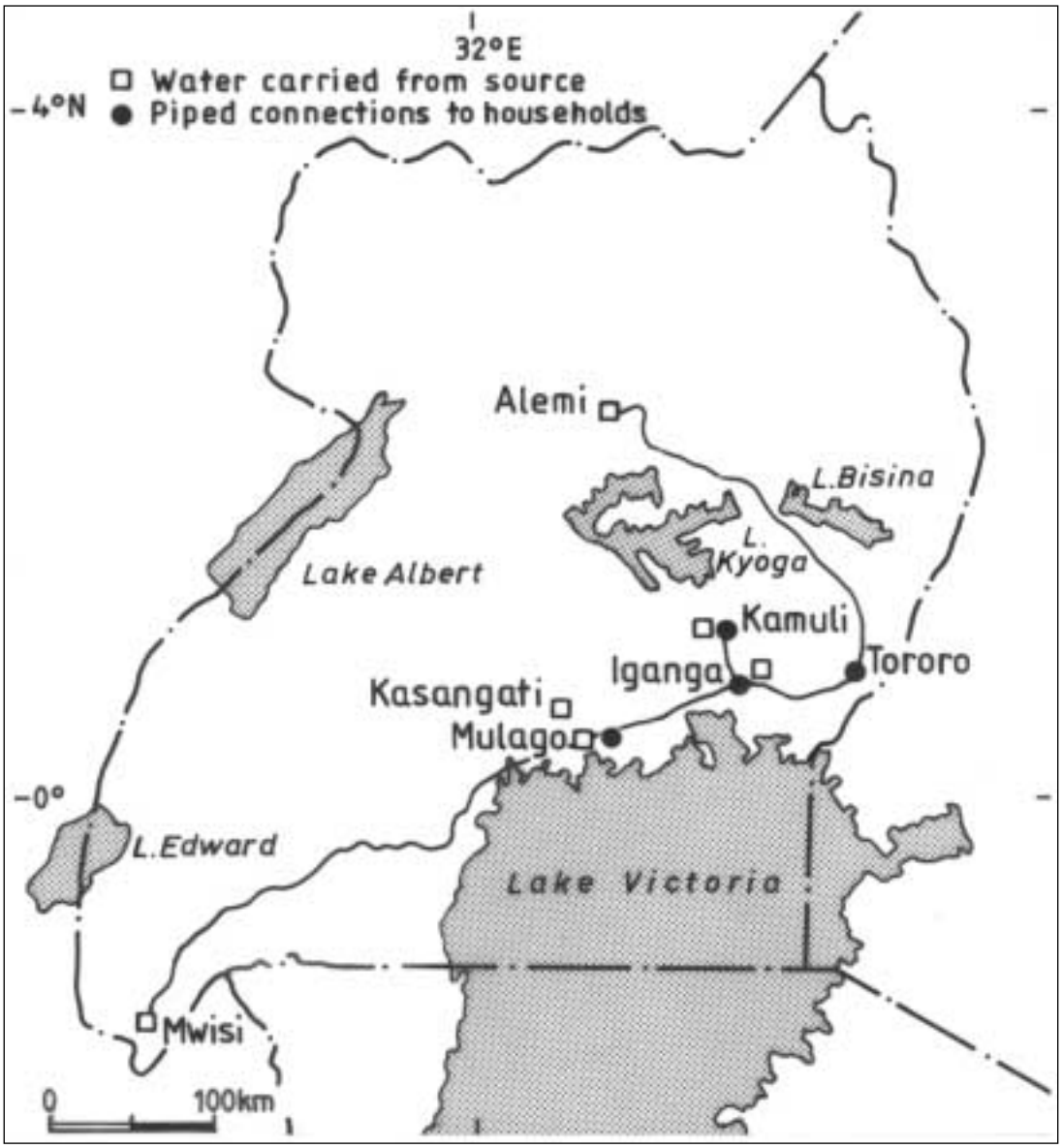


Figure 1.1 Map of Uganda

2 Country Profile and Study Sites

2.1 Uganda's Modern Political History Dominated by Conflict and Mismanagement

Prior to independence in 1962, Uganda was a British Protectorate where land and other resources were not appropriated by the colonisers. The British established a small but very efficient civil service with a road network and telecommunications infrastructure that was the envy of East Africa.[3] However, the excellent infrastructure, which included well functioning piped water supply systems, was almost entirely limited to the privileged urban dwellers who constituted less than 10 percent of the country's population.

Ethnic as well as religious divisions were very strong. Amongst Christians, the Protestants and Catholics were often antagonistic with low-grade conflict and rivalry that was somewhat similar to the religious divide in Northern Ireland. Development projects were inequitably distributed, with the north and north-east regions lagging behind the rest of the country. These inequities set the stage for the conflict, mismanagement and militarisation of politics that was to characterise much of the post independence era.[4] Between Independence in 1962 and 1986 when the current National Resistance Movement (NRM) administration took power, Uganda had nine governments, only one of which was popularly elected.

The expulsion of Asians and subsequent appropriation of their property and investments by Idi Amin and his allies inflicted far-reaching damage on the economy and social fabric. This damage is only beginning to be repaired.

3 Senteza – Kajubi, W. 1987. Background to War and Violence in Uganda. In: Dodge, C.P. and Raundalen, M (eds.) War, Violence and Children in Uganda. Norwegian University Press.

4 Macrae, J., A. Zwi and H. Birungi. 1993. A Healthy Peace? Rehabilitation and Development of the Health Sector in a Post Conflict Situation - the Case for Uganda Report of a Pilot Study. Health Economics and Financing Programme, Health Policy Unit, London School of Hygiene and Tropical Medicine.

2.2 Political Reforms and Decentralisation

The NRM attempted to stem the political and socio-economic decline through a series of policies and reforms. Thus a participatory local government structure was set up right from the village to the district level. All people over the age of 18 are members of the local (village) council (LC1) and elect their LC1 committee which is responsible for critical issues in the village such as women's affairs, finance, health, education, mobilisation and defence. The LCs are legally mandated to initiate development projects and activities in response to local needs and challenges. The system operates at five levels: the village (LC1), the parish (LC2), the sub-county (LC3), the county (LC4) and the district (LC5).

This system of decentralization, in which each layer of local government retains 50 percent of the tax revenue it collects, is a big step forward from the old top down authoritarian system that was neither participatory nor responsive to people's needs and aspirations.

2.3 Civil Service and Economic Reforms

During the 1990s, the Government of Uganda instituted civil service reforms, which include the retrenchment of civil servants in order to have a smaller and more efficient service. The fiscal policies have also been tightened and linked to liberalization of the economy along lines advocated by the IMF and World Bank. Inflation has been largely brought under control, being reduced from around 250 percent per annum in 1986 to below 10 percent in 1997, while GDP has continued to grow at more than five percent per year over the past five years.

However, this remarkable improvement in the economy has not been felt in people's pockets or in their level of well being.[5] Fifty-five percent of the population are classified as poor - 36 percent cannot afford adequate food and 19 percent are considered 'core poor'.[6] Insecurity in the north (Lord's Resistance Army) and in the west (Allied Democratic Forces) remains a major problem and has been confounded recently by the conflict in the Democratic Republic of the Congo and the simmering ethnic and quasi-religious conflict in Southern Sudan.

5 Tumwine, J.K., E.A. Mworozi, T. Waterston and D. Logie. Health and Socio-Economic Trends in South Western Uganda, 1988-1995 (in press).

6 Burton, T. and G. Wamai. 1994. Equity and Vulnerability Situation Analysis of Women, Adolescents and Children in Uganda. National Council of Children: Kampala.

Policies and enabling legislation have been put in place to facilitate greater community involvement and gender equity in key sectors of the economy, including the water sector. The evolution of these laws and policies in the water sector will be considered in more detail in another document.

2.4 Main Actors in the Water Sector

The National Water and Sewerage Corporation is a government parastatal organization responsible for water and sanitation in 11 urban councils of Kampala, Jinja, Tororo, Mbale, Entebbe, Masaka, Mbarara, Gulu, Lira, Fort Portal and Kasese. They are responsible for investment, operations and maintenance. Unfortunately the corporation has had its operations curtailed by a huge debt portfolio. By 1997, the corporation was owed over 24 billion Uganda Shillings which represented almost a whole year's turnover. Government ministries, domestic consumers, commercial and industrial complexes were the main culprits as shown in Table 2.1.

Consumer	Amount owed in billions of Uganda shillings	Percent
Government ministries	8.2	32.9
Government parastatals	1.1	4.4
Departed Asians Properties Custodian Board (DAPCB)	2.9	11.6
Institutions	0.8	3.2
Industries and commercial premises	5.9	23.6
Local authorities	0.5	2.0
Domestic consumers	5.5	22.0
Embassies	0.06	0.2
Total	**24.96**	**100**

Table 2.1 The Uganda National Water and Sewerage Corporation Debt Portfolio by Consumer in Billions of Shillings, 30 June 1997
Source Ssendawula, 1997[7]

Although the Government has embraced market-led economic reforms, privatisation of the corporation is not yet on the cards. Rather the corporation's strategy is to change from conventional methods of provision of utility services to a more market-driven approach for this 25 billion shillings industry.

7 Ssendawula, G.M. 1997. Policy statement on the 1997/98 budget estimates presented to Parliament. Ministry of Natural Resources, Kampala, Uganda.

The Directorate of Water Development is mandated to develop water services in the emerging towns, trading centres and rural areas. The Directorate largely relies on donor funding and in June 1996, completed a US$ 8.6 million construction of Fort Portal and Kasese water supplies with financial support from the German Government. The National Water and Sewerage Corporation is in charge of the operation and maintenance of these two water supply networks. The Directorate has also completed a US$ 3.7 million rehabilitation of water supply systems in the seven towns of Arua, Dokolo, Kumi, Kitgum, Pallisa, Moyo and Soroti, under the Northern Uganda Reconstruction Programme. These water supply systems have been handed over to the LCs, which will arrange management of the water supplies through community groups. Construction of Adjumani water supply in the northeast is also underway and is being financed by UNICEF and DANIDA at a cost of US$ 318 million. Unfortunately none of these projects falls within our area of study.

Elsewhere, the World Bank (IDA) has supported the implementation of the Small Towns' Water and Sanitation Project (STWSP) in the towns of Wobulenzi, Luwero, Busia, Malaba, Lugazi, Rakai, Kyotera, Lyantonde, Kalisizo, Ntungamo and Rukungiri. Rakai has also benefited from the emergency construction of a water system financed by DANIDA in 1997. DANIDA has also provided US$ 17 million in assistance for the implementation of the Eastern Centres Water and Sanitation Project (ECWSP) in 11 small towns, namely: Budadiri, Lwakhakha, Budaka, Pallisa, Naluwerere, Busembatya, Kaliro, Kamuli, Buwenge and Busolwe. Kamuli is one of our study sites. Elsewhere, the water supplies for Hoima, Masindi and Mubende will be rehabilitated using US$ 15 million from the EU.

Through these and other interventions, the proportion of the population with access to potable water in Uganda's urban areas will soon reach 60 percent. However, it must be noted that the poor, especially the slum dwellers in these towns, still do not have access to reliable water sources.

Through the South Western Town and Sanitation Project, water and sanitation committees initiated the protection of springs and laying

pipelines for water supplies in the small trading centres of Muhanga, Kabirizi, Bugangari, Ryakarimira, Kebisoni and Kambuga. In the rural areas, the Government assists communities in the rehabilitation of boreholes, drilling and installation of new boreholes, as well as in the construction of dug wells, protection of springs, and gravity water schemes.

Through the RUWASA project, DANIDA and the Ugandan Government have assisted communities in Mukono, Kamuli, Tororo, Mbale, Kapchorwa, Pallisa, Iganga, Bugiri and Jinja districts to improve water and sanitation services.[8] In the 1996-2001 phase of the RUWASA project, emphasis is on the privatisation of construction of water sources and supporting districts to take over management of the water supplies in their areas.

8 Ssendawula, G.M. 1997. Policy statement on the 1997/98 budget estimates presented to Parliament. Ministry of Natural Resources, Kampala, Uganda.

2.5 Profile of the Ugandan Study Sites

2.5.1 Rural Sites

2.5.1.1 Alemi (site 23 - unpiped)

Alemi comprises the whole of Alemi parish which, is found in Ayer subcounty, in Kole County of Apac district in Northern Uganda. Apac district lies between latitudes 1° N and 2° N and longitudes 32° E and 33° E, in the Acholi-Kyoga zone, which embraces the greater part of Northern Uganda. The River Nile borders it partly as Lake Kyoga and Lake Kwania, which forms a wide but gentle flowing river. Papyrus and reed swamps fringe the rivers from the lakes and the rivers drain into the Nile from the East.

The land is generally flat with an attitudinal range of 1000-1300m and a few hills. The dominant soil type is yellow to yellowish brown, ferralitic sandy clay loam to sandy loam with moderate fertility. Unfortunately, the soils are highly weathered and strongly leached. This represents the final stages in tropical weathering. The area receives bimodal rainfall averaging 1000 to 1200 mm per annum. The first rainy season is from March to May, while the second is from August to September or October. The district is covered by wooded savanna, which consists of scattered deciduous trees and shrubs in the

grassland as well as perennial grasses and papyrus in the swamps. Apac district (formerly part of Lango district) covers a land area of 5887 km^2 and is mainly inhabited by the Langi people who speak the Lango language. In the 1991 Housing and Population Census, the population was recorded as 454,504 with an annual growth rate of 3.38 percent.[9]

Alemi parish itself had a population of 4,533 with a population density of 100-149 per km^2. It lies to the south of a large swampy area of the Okole River whose line of flow is concealed by an expanse of reeds and papyrus. Although the river is used by several households as a source of water for domestic use, it is mainly used for fishing. Fishing is carried out using fish traps or spears. Groups of men armed with multipronged spears and walking shoulder to shoulder through muddy water and spearing any fish they come across are as common a sight as they were three decades ago.

More than two thirds (71.8 percent) of the economically active population aged over 10 years, are engaged in subsistence agriculture.[10] The recent increase in population, and engagement in agriculture, has caused land shortage and inevitable land disputes among the inhabitants. It has also led to a change in settlement pattern with people moving from the fertile uplands to the edges of the swamps especially in Alemi. In the site, use of communal labour for cultivation in working groups (*awak/alulu/aleg*) under the leadership of one active member (*adwong awak*) is a common practice. Maize, beans, millet, sorghum, groundnuts and pigeon peas are the main food crops while cotton, tobacco, sunflower, and soya bean are the main cash crops. Brewing of a thin fermented porridge (*kongo lango/malwa*) from millet or sorghum and of potent local gin (*waragi*) from cassava/millet flour is another source of income for those engaged in the trade.

Apac district, like many other districts in northern Uganda has experienced turbulent disruptions in its social and economic activities since the 1979-liberation war that removed Uganda's notorious dictator Idi Amin. Subsequent looting and insurgency together with cattle rustling by the neighbouring Karimojong warriors have hindered development efforts. Although a degree of calm has

9 Ministry of Finance and Economic Planning (MFEP). 1992. The 1991 Population and Housing Census (District Summary Series). MFEP Statistics Department: Entebbe.

10 Ministry of Finance and Economic Planning. 1992. op cit.

recently returned to the region, regular raids by the rebel Lord's Resistance Army (LRA) into the neighbouring districts of Lira, Gulu and Kitgum leaves the security situation somewhat precarious.

2.5.1.2 Mwisi (site 27, unpiped).

This site is found in Kitumba subcounty in Ndorwa County in Kabale district, southwestern Uganda. The hilly area consists of flat-topped ridges, which quickly give way to very steep middle parts with slopes of 10-25 percent declining to 5-10 percent in the lower parts down to the V-shaped valleys. Because of this topography, the area is prone to accelerated soil erosions. In 1945, a bylaw to enforce terracing, in order to stem erosion, was passed.[11] However, after independence in 1962 most of the conservation measures were neglected. In fact many of the remaining terraces (or *enkingo* as they are called in *Rukiga*, the local language) are inefficient and very unstable as they have very little or no vegetation on them. Some of the households have removed the terraces in order to increase arable land making use of the fertile soil from the terraces, which have remained fallow for a long time. In addition it is quite common for cattle to be herded on to the plots for grass and sorghum stem residues. These cattle also contribute to the destruction of the terraces.

11 Directorate of Water Development. 1995. Uganda Water Action Plan: 2.1-5.2.

The population density in the area has increased from 170 per km^2 in 1969 to 246.1 per km^2 in 1991 (Ministry of Finance and Economic Planning, 1992). Worse still because of the population pressure, there is intensive cultivation of the very steep slopes. Because of these factors, the fields are left bare and are prone to soil erosion. Cutting of trees especially the black wattle tree cover, leads to very little infiltration and the excess runoff creates floods with erosion. When it rains heavily as a result of the *El Nino* phenomenon as was recently experienced in East Africa, huge amounts of water collect in the valleys. The rains create a lot of gullies, which continue down the water sources along the Kiruruma River.

2.5.1.3 Iganga (site 24, unpiped)

With a population of almost one million (945,7835), Iganga district is situated 100 km east of Kampala (Uganda's capital). The district

shares its borders with Bugiri and Pallisa districts to the east, Kamuli and Jinja to the west and Lake Victoria to the south.

This site is situated to the north of Iganga town, stretching from Busei trading centre along the Iganga Tororo highway to Namadope dam, 10 km on the Iganga Kamuli road. The site cuts across Nakalama and Bulamagi subcounties in Kigulu county and Waibuga subcounty in Luuka county. The total population of this site is approximately 10,708, with a population density of 250 to 299 persons per km^2. Like the neighbouring Kamuli district, the landscape is flat with some gentle undulating hills (slopes ranging from 3-5°) and an altitude of 1,100-1,300m. Average rainfall is 1,360 mm per year, falling in two seasons - March to May and September to November.

The biggest ethnic group are the Basoga, with 88 percent of the economically active population (aged over 10 years) involved in subsistence agriculture, growing mainly maize, coffee, cassava, sweet potatoes, beans and *matooke*.[12] The soil types are red friable clays, red to dark friable clays with laterite horizon sandy clay loams.[13] The original forest savanna mosaic vegetation has been replaced by bushes of *Lantana camara* covering 28 percent of the land area, as has happened in Kamuli district.

12 Ministry of Finance and Economic Planning. 1992. op cit.

13 Directorate of Water Development. 1995. op cit.

2.5.1.4 Kasangati (site 28, unpiped)

This study site lies 17 kilometers from Kampala the capital city of Uganda. The relatively easy road access makes it one of the satellite "bedroom" areas providing accommodation to people who commute to work in Kampala. As they did 30 years ago, households survive on subsistence agriculture. However, a good proportion of them now keep several exotic dairy cattle in their homesteads. This is part of the "zero-grazing" scheme where grass for the cows is bought from "grass vendors" who move around on their bicycles selling the grass.

Housing in Kasangati is better than most other rural areas in Uganda. Most of the houses (70 percent) have metal roofs, while almost half (46 percent) of the houses have walls made of permanent materials (concrete, brick, stone). We came across several homesteads with

rain catchment systems in which the rainwater is collected from the roof and stored in underground tanks.

The landscape is high plateau with narrow/undulating flat-topped hills, at an altitude of 1,150 to 1,350 metres above sea level. Papyrus swamps occur in the poorly drained valleys, some of which have been reclaimed for agriculture. Soils range from brown/yellow sandy clay loams to dark red friable clays.

2.5.2 Urban Sites

2.5.2.1 Iganga (sites 25 and 34)

Site 34 (classified in DOW I as piped) is situated in Iganga town along the Main Street, Old Market Street and Oboja road. Iganga town is located along the Kampala to Tororo highway, which links Mombasa to central Africa. The town has a population of 19,740 and a population density of over 350 per km^2.[14] The major economic activity is business. The town has undergone considerable growth with new buildings going up both in the centre of town and in the suburban area. *Site 25* is also within Iganga town and stretches from the mosque near the central market including Saza Road up to, but excluding, the current Iganga district administration block.

The piped water system in Iganga town has deteriorated to such an extent that only 13 percent of households now receive piped water. Moreover, even for those households which do receive piped water, the water just trickles in for one to two hours daily and some households reported spending over three days without water in their taps! The water pressure in the pipes is so low that water cannot flow to the tanks. When contacted over the issue, the town's Water Department said that a short-term plan has been made to repair the system so that more water can be pumped to the piped households and water kiosks. They explained that the long-term plan was to pump water from Lake Victoria at Buluba, 18 km from the town. This plan is in its initial stages of resource mobilization from donors and government, but as yet, little has been accomplished.

14 Ng'wandu, Pius, Y. 1998. Opening Address by Honourable, Dr. Pius Y. Ng'wandu, (MP), Minister for Water, to the *National Workshop on the Review of the Rural Water Supply Component of the National Water Policy*, Arusha, 23–25 April 1998.

2.5.2.2 Kamuli (sites 26, 35 - piped)

These two study sites are located in Kamuli, a small town of 6,495 people which is the headquarters of Kamuli district, one of the four districts carved out of the former Busoga region. Kamuli has a central commercial district where Asians used to live in or near their shops but who saw their stay terminated in 1972 by Idi Amin's summary expulsion of Asians from Uganda. A few Asians have since returned but the town is now largely occupied by indigenous Ugandan Africans who are engaged in trade or agriculture, or work in the district administration offices.

Kamuli town is located at the end of the tarmac road from Jinja, which is located some 60 km away. The district shares its borders with Mukono to the west, Iganga and Pallisa to the east, Jinja to the south and Soroti and Lira to the north. The Victoria Nile forms its natural boundary with Mukono to the west; while Lake Kyoga forms its natural boundary with Soroti and Lira to the north. Generally, the landscape is flat with some gentle undulating hills. The altitude is between 1,100 and 1,300 metres.

Of the economically active population, 90 percent are engaged in subsistence agriculture.[15] The soil types are red friable clays and red to dark friable clays with laterite horizon sandy clay loams. These soils are fertile and support a number of crops, which include bananas (*matooke*), sweet potatoes, cassava, maize, beans, peas, groundnuts, sesame seed, as well as robusta coffee. The original forest - savanna mosaic vegetation - has been replaced by bushes of *Lantana camara* covering 28 percent of the land area. *Lantana camara* spreads very fast and it is not uncommon to find it even in people's compounds! Most of the land is under cultivation (66 percent) with no trace of tropical forest and only limited savanna woodlands (about two percent of the area), but with no grassland at all.

15 Ministry of Finance and Economic Planning. 1992. op cit.

The area has an annual rainfall of 1000-1500 mm coming in two seasons, March to May and September to November.

2.5.2.3 Tororo (site 36 and 37 piped)

These two study sites are located in Tororo municipality in Tororo (formerly Bukedi) district in the eastern region of Uganda adjacent to

the Kenya-Uganda border. Iganga and Bugiri districts in the west, Pallisa and Mbale border it in the north, the Republic of Kenya in the East and Busia district in the South. It lies between latitudes 0°N and 1°N and 33°E and 34°E, adjacent to the banana belt. The town is built around a major railway junction and saw several of its industries (cement, asbestos, insecticides, and others) close down during the decades of political turmoil. It is only recently (in the 1990s) that the cement industry has been privatized and started production.

Much of the district is flat with the exception of Tororo Rock (4865 feet above sea level) and the Sukulu rings, which lie along the eastern border of the district. The low-lying areas or valleys include Doho Namatala region, Mpologoma swamp areas, and Malaba and Manafwa valleys. Two main rock types - precambrians and tertiary pre-Elgon volcanoes, underlie the area. However, the Precambrian rocks of basement complex (granites, gneisses, quartizites and metamorphic rocks occupy much of the district). Outcrops of tors and exfoliated boulders lie in the valley bottoms especially of rivers Malaba and Mpologoma. Plugs at Tororo rock and Sukulu are eroded remnants of the prominent mountains of Southern Karamoja and Elgon.

With an overall population density of 239 persons per km^2, Tororo district is one of the most densely populated in Uganda. The population in 1991 was 555,574 and the population pressure continues to increase due to immigrations and shortage of land and insurgency in neighbouring districts. Tororo Municipality has the highest population density in the district (over 350 persons per km^2) and a rapid rate of population growth. The Municipality's population has increased from 5,365 in 1959 to 26,783 in 1991.

Tororo Municipality is ethnically diverse, the major ethnic groups being the Japadhola, Iteso, Banyole, Basamya, and Bagweri. The Japadhola are the dominant tribe followed by the Iteso and Banyole, Samia and Bagwere. A few Europeans and Asians, working in the industries and commerce, are still resident in Site 36.

The district has bimodal rainfall with the first rains coming from

March to June and the second from August to November. Although rainfall is variable and difficult to predict, it easily rains especially around the Tororo rock. The area has distinct wet and dry seasons with an annual rainfall of 1,130-1,730 mm. The soils are ferralitic and mainly sandy looms. The vegetation ranges from medium altitude forests to papyrus swamps and savannas. In Site 36, trees are planted (acacia, etc.) in almost all the compounds.

There are two hospitals (one public and one private) and several private clinics and drug shops. The luxurious Tororo Rock Hotel is located at the extreme end of Site 36, and is a major recreational centre for both local and foreign tourists. As a border district, Tororo has experienced a rapid growth in cross-border trade, most of it contraband. Other than providing a livelihood through petty trade and smuggling, it contributes nothing to the district treasury. Smuggled goods including petroleum products, sponge mattresses, canned foods, salt, soap and sugar from Kenya are sold cheaply in the shops and on the streets.

Tororo Municipality gets its water from the River Malaba. Although the river water is of very poor quality due to mud and pollution, the municipality has very clean and reliable water. The water is processed through several stages of purification at the River Malaba water pumping station before being declared fit for human consumption.

2.5.2.4 Mulago (site 29)

The Mulago site is located in Kampala district in the Kawempe division of Kampala City. This site is to the north of Mulago I, II and III and Kyebando. The largest new and old Mulago hospitals in Uganda are just outside the site. The area immediately adjacent to the hospital is a typical urban slum with high diversity of ethnicity representing most tribes of Uganda.

According to the 1991 Population and Housing Census, this site has two levels of population densities with Mulago I and II having a density of 17,000 people per km^2 and Mulago III having 13,000 to 16,999 people per km^2. Mulago has a population growth rate of 4.76

percent, which is high relative to a rate of 3.14 percent for the rest of Kampala district.

The site has a population of over 50,000. The area has undergone great change since 1967 in terms of urbanization, privatisation and modernization influences. In contrast to 30 years ago, its inhabitants now come from a range of different professions, educational levels and income levels. Only 4.1 percent of the economically active population is engaged in agriculture while 57.5 percent are employed, 22 percent engage in trading, 2.1 percent earn their livelihood through subsistence farming and 9.8 percent rely on support from other family members. Thus in the majority of households, at least one member has some sort of employment bringing in varying levels of income.

However, the majority of inhabitants (57.5 percent) live in one-roomed households, which indicates that they earn low incomes and thus live in overcrowded conditions. This might affect their decisions on where to collect water from, how water should be used and for which purposes. Some homesteads possess out-houses which are mainly used as kitchens and have very dirty roofs made of old *debes* (tin) which have been beaten into shape. Scattered amongst these unsightly slums are many new neatly painted bungalows of modern and permanent design. Some have iron bars for burglar proofing, large glass window frames and are fitted with concrete or plastic water storage tanks. There are a few mud-walled, corrugated iron roofed houses, which are surrounded by banana (*matooke*) crops in Mulago, Kalerwe, Mawanda Road, and Kyebando and Nsoba areas. A modern electric substation supplies electricity to the area. There are several primary schools and shops. Makerere University and the Medical School are only a stone's throw away.

At the end of 1997, Kafeero zone - a village in Old Mulago - was dislocated to give way to a new entrance to Mulago Hospital and to accommodate a new accident, emergency and assessment centre.

Site Maps

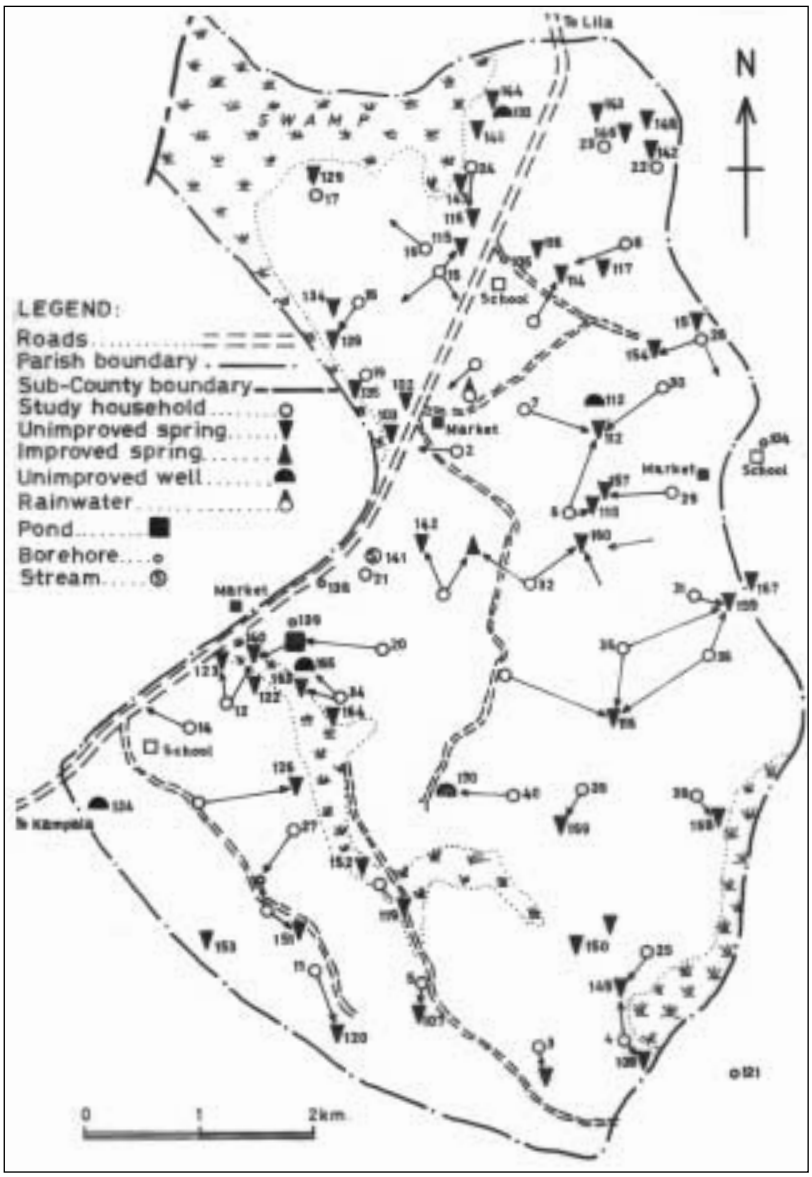


Figure 2.1. Alemi

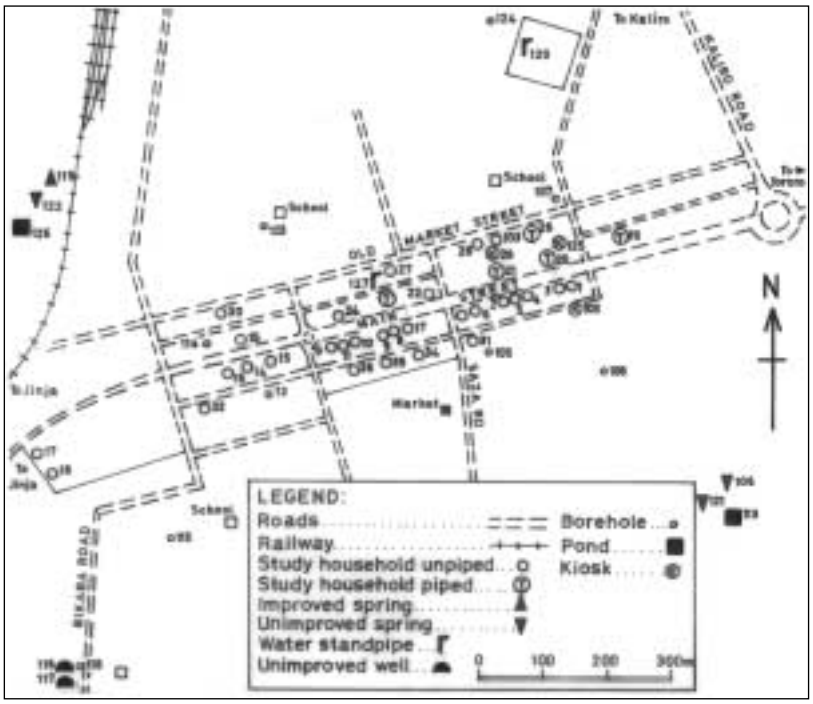


Figure 2.2 Iganga Urban

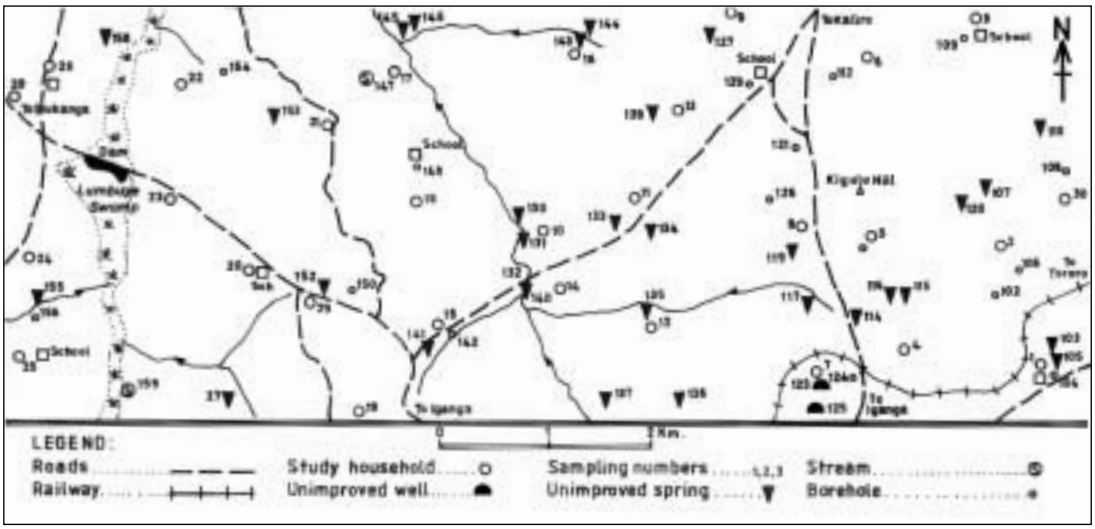


Figure 2.3 Iganga Rural

Figure 2.4
Kamuli Unpiped

Figure 2.5 Kamuli Piped

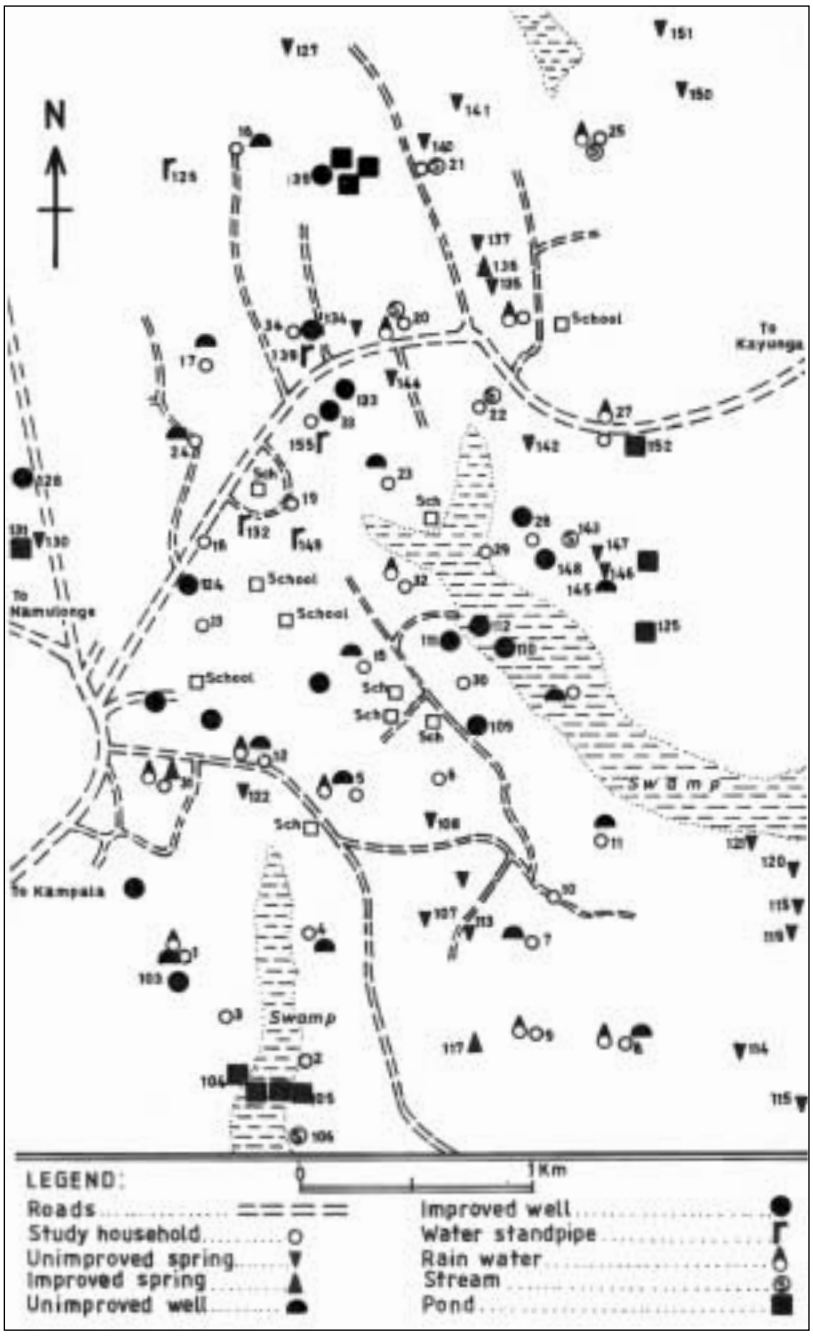


Figure 2.6 Kasangati

Figure 2.7 Mulago

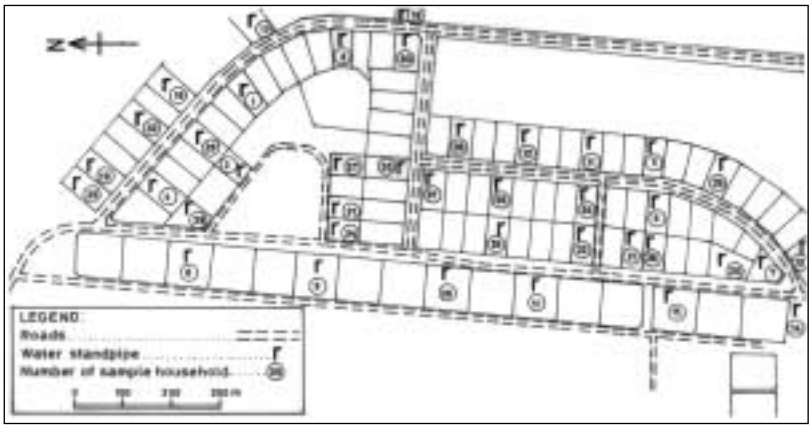


Figure 2.8 Tororo

3 Methodology

3.1 Study Type and Design

This cross-sectional study was carried out in 1997 in the 11 Ugandan sites studied in DOW I. Selection of these sites by the DOW I study team was "purposive", based on the available field assistants who returned to their home areas to carry out the study. Our aim was to carry out a repeat cross-sectional study to gauge changes that had occurred in domestic water use and environmental health over the three decades since the 1967 study.

In addition to returning to the original sites, similar research methods were used. The sites selected provided a diverse range of physical and social settings including urban/rural and piped/unpiped. Four of the field sites (Iganga rural, Mwisi, Kasangati and Alemi) were rural, while seven were urban (2 in Tororo, 2 in Iganga, 2 in Kamuli and Mulago in Kampala). The sites selected were of diverse environmental conditions and gave a reasonable contrast between arid-humid and hilly-plateau. Some, such as Mulago in Kampala and Tororo in Tororo, were integrated into the market economy while others, like Alemi in Apac, were still peripheral to this. Diverse technological conditions also persisted between sites, ranging from primitive seeps, wells and protected springs to intricate urban water systems. Each of the study sites is described briefly in Article 2.

3.2 Selection and Training of Field Assistants for the Research

In DOW I, field assistants were recruited from the University of East Africa (Makerere). They spoke the local languages used in the field sites. In the current study, however, we decided to use university graduates who spoke the local languages. Advertisements were placed in the national newspapers for six field assistants and the

response was overwhelming. Almost 400 applications were received from which a short list was made for written and oral interview interviews. People failing the written interview were not retained for the oral interview. A multi-disciplinary team of field assistants was recruited, with experience in forestry, statistics, social science, food technology, participatory research and environmental studies.

The Ugandan field assistants trained for two weeks at Kasarani, Nairobi, together with those from Kenya and Tanzania. Training involved intensive workshop and fieldwork sessions and provided an opportunity for the field assistants to be familiarised with the history of the study, objectives and methodology. Field assistants were introduced to techniques for measuring slope, time, distance, water, volume, water flow, mapping and sampling. They then practised with these new techniques and research skills in one rural and one urban field site. Each field assistant was given a wide array of field equipment and materials including a camera, film, 25-metre tape measure, precision clinometer, weighing scales, backpack, waistpack, office supplies and first aid kit.

3.3 Sampling, Survey and Measurements

3.3.1 Sampling Method

Unpiped Sites. Sample households in unpiped sites were selected using a grid of 21 to 27 cells over an area of three square miles. A point within each cell was selected by using co-ordinates of random numbers, and the household nearest the point was chosen for interview.

Piped Sites. Piped sites were limited to the original urban areas studied in DOW I, namely, Kamuli, Iganga and Tororo. Using maps of land use, the towns had been divided into areas having approximately the same density of residential structure per plot. Residential density was defined in DOW I as follows:

- *Very-low density*: built-up area does not exceed 15 percent of the plot on which it is built;
- *Low density*: built-up area does not exceed 40 percent but is more than 20 percent of the plot on which it is built (with garage/servants' quarters);

- *Medium-low density*: built-up area does not exceed 60 percent but is more than 40 percent of the plot on which it is built (with or without garage).
- *Medium-high density*: built-up area does not exceed 90 percent but is more than 75 percent of the plot on which it is built (without servant's quarters, but may occasionally have a garage)
- *High density (unplanned)*: built-up area occupies 98 to 100 percent of the plot on which it is built and the plumbing layout is separate (without garage and servants' quarters).
- *High density (planned)*: the type of planned housing provided for employees, e.g. railway quarters and police lines, where common facilities exist such as toilets, standpipes, kitchen and laundry places (without garage and servants' quarters).

Within areas of similar housing density, samples comprised every 10th house beginning at a number selected at random.

3.3.2 Field Procedures

For piped and unpiped households, all interviews were conducted during or at the margins of wet periods - this permitting a measure of water use when supply and number of possible sources were at their maximum.

Unpiped Sites. In unpiped sites, field assistants memorized the questionnaires and completed the forms after the interviews. At each household, semi-structured interviews were conducted, observations made, and the slope and distance to water sources measured. Data was collected on domestic water use, socio-demographic characteristics, prevalence of diarrhoea, state and use of latrines, sources of water and conditions of use. Wherever possible, reported water use was checked by interviewing other respondents in the household and by observing the actual number of trips to the water source(s). In each household, observations were carried out from 6 am and 8 pm. Water used between 8 pm and 6 am was estimated by interviewing household members.

The actual amount of water used was measured by weighing it on a scale obtained for this purpose. Where the amount used was too small

to be measured accurately a container of known volume, such as a half a litre mug, was used to estimate the amount. Distance to the water source(s) was measured using a tape measure or by pacing. The time taken to and from, and waiting time at, the source was noted. The weight of the drawer was also recorded. The slope of the road or path to the water source(s) was measured using a clinometer. Information on environmental health, particularly on the prevalence of diarrhoea, and state and use of latrines, was obtained by interview and observation.

A map of each household was sketched on graph paper and all study households and water sources were marked on the location map.

Piped Sites. For piped sites, meter readings for a full year were obtained, where available, from the local water or town council office. The interviewer then stayed in the house to crosscheck the information obtained and to complete the study questions. As in the unpiped sites, interviewers spent a whole day, from 6 am to 8 pm, in each household. Observation was necessary since a good proportion of previously piped households were either found to be no longer piped (Figure 3.1) or did not have reliable water bills.

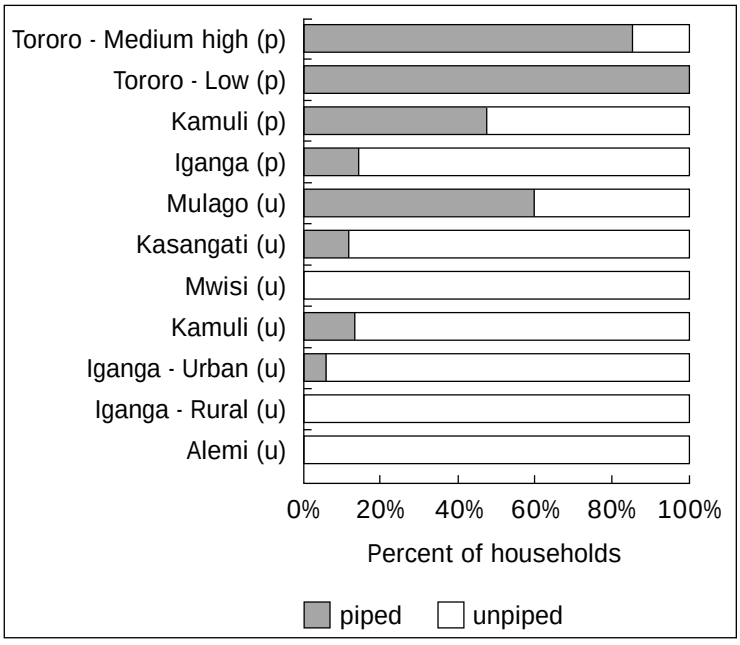


Figure 3.1 Percentage of Sampled Piped and Unpiped Households by Site

Note
(u) Site was 100% unpiped during DOW I
(p) Site was 100% piped during DOW I

3.4 Participatory Research

This second phase (Participatory Learning Appraisal [PLA]) of the *Drawers of Water* study was conducted in four selected sites of Alemi (Apac district), Tororo senior quarters (Tororo district), Iganga town (Iganga district) and, Mwisi (Kabale district). The four sites were selected from the 11 original sites studied in both DOW I and DOW II because of unique and striking findings revealed after DOW II phase II conducted in 1997.

Alemi site was selected for the participatory study because its water use situation appeared to have remained static over the past 30 years with most people still using the unprotected, traditional sources (seeps). In addition there was high prevalence of diarrhoea cases in the households.

Whereas Tororo, site 36, was selected for its relatively high per capita water consumption, and the good performance of NWSC for providing high quality services, Mwisi rural site was chosen because of its relatively very low per capita water consumption (the lowest in East Africa) and environmental degradation due to population pressure, poor agricultural practices and the brick making industry.

Iganga urban site 34 was selected for the breakdown and deterioration of a once well-functioning piped water system in the 1960s to a nearly 'unpiped' system, and the failure of the local municipal council to meet demand leading to an unprecedented increase in the number of private water providers.

Alemi and Mwisi were rural and had unpiped households while Tororo was urban and piped. Most of the households in the Iganga site were unpiped despite being in the urban area.

3.4.1 Selection of study villages and local facilitators

In Alemi the research team, local leaders (LCI chairpersons) of the parish, together with community members discussed the selection of the villages for the study. A list of all villages in the parish was drawn from which two villages were selected. These were Alege and Abako villages. However, only one village was studied in detail, while the

other could not be studied due to time constraints. Two local facilitators were selected from the community to ensure rapport and assist in understanding of cultural and other issues. They also assisted with translation for some members of the team who did not understand Lango the local language.

In Tororo, the research team and the LC III chairperson, Eastern Division came up with one LC I, Amagoro A, out of the two LCs in the site. Amagoro A village was selected because all its households were in the study site unlike the other village which had part of its households out of the study area.

In Iganga the local women's leader, a very active and popular woman, assisted the team to mobilise women, men, and the youth for the different meetings.

In Mwisi, the research team led by a facilitator discussed with the LC II chairman of Mwisi parish and selected one village which was experiencing environmental degradation.

3.4.2 Protocol and appointments

Letters of introduction to the CAOs, copied to the RDCs, and the LC V chairpersons of the districts of the selected sites were taken a week in advance of actual fieldwork. The letters explained the purpose of the study, when and how long the team would take in the district. This was also to request for permission to undertake the study and mobilise the local community before hand. At the districts, the CAO provided letters introducing the research team to the leaders in the study sites where the research was to take place.

3.4.3 Entry into the villages

The research team visited the subcounties in which the selected sites were located where the sub-county leaders (either the subcounty chief or LC III chairperson) was contacted. This was to inform the community of the team's presence in the area and seek permission to carry out the study. Using the letters from the CAOs offices of the respective districts, the team was granted a go ahead and proceeded

to the meeting place. The CAO letters were also to seek support of the community leaders in mobilising the people.

As a starting point, an open group meeting was held in every study site.

During the meetings, the research team introduced itself to the participants, where they were coming from, explained the background and purpose of the study and how long it would take. The team also used this opportunity to briefly present the findings of the DOW II Phase I study, and the reasons for the PLA study. Thereafter the village in which the exercise was to take place was selected. After selection of the village, a program for the days activities was drawn - setting appropriate times for the meetings, avoiding market days and busy times of the day, and not forgetting women's busy schedules.

3.4.4 PLA Exercises/Data Collection

The process of actual data collection and exercising PLA techniques varied greatly depending on whether the site was rural or urban. PLA exercises were much easier in the rural areas than in the urban sites due to problems of mobilisation. All in all, a number of tools were used to collect data. These included: open group discussions, focus group discussions, semi-structured interviews, resource maps, matrix scoring, pairwise ranking, time lines, pie charts, Venn diagrams, transect walks, observations, daily activity chart (daily routine), key informant interviews, seasonal calendars, cause-effect diagrams, flow diagrams and mini case studies.

Various groups and individuals were handled separately which were useful for triangulation purposes and cross checking.

Open group meetings: This was used as an eye opener to the community members who came for the meetings. The research team used the meeting to make themselves known to the community, and the purpose and objectives of the study. A feedback of the results of the household survey was made at each of these meetings.

It was also in these meetings that the villages for the participatory

study were selected, and appointments for the preceding exercises made. A total of three such meetings were held in Alemi, Mwisi and Iganga. However, it was not possible for Tororo site due the problem of mobilisation. People did not turn up in large numbers for the meeting in Tororo.

Focus group discussions (semi-structured interviews): Different groups of women, men, school children, teachers, elders and mixed groups were held. During the discussions, other PRA tools were applied: matrix scoring, pairwise ranking, institutional analysis using Venn diagrams and gender analysis using routine diagrams.

A total of four women groups, four men groups, three groups of school pupils, two mixed (men & women) groups, one group of female TTC students, another for male TTC students, and one group of elders (mixed) were conducted.

Resource maps: In both rural sites, resource maps were drawn showing the location and type of the water sources in the community, the time they came into existence, the existing/ existed infrastructure such as churches, schools, dispensary, trading centre, and the physical features - swamps, hills, water bodies.

Transect walks and observations: The research team together with some community members walked through the villages. This enabled the team to observe the location of the various water sources, distance to source and community activities that consume water away from home, vegetation type and the topography of the village. Also observed were the infrastructure, physical features, existence of latrines in Alemi, and environmental degradation in Mwisi.

Preference and trend analysis: pairwise ranking and matrix scoring (sources against drawers, sources against transport, water uses against gender, diseases against causes), were used for preference and priority analysis. Trend analysis of water uses and occurrence of diseases over years was also done using trend diagrams, seasonal calendars and time lines.

Daily activity chart: This was used to determine the men's and women's daily routine activities (gender issues/roles) regarding water collection and use in the communities.

Key informant interviews: (mini case studies) with LCs, elders, NWSC, NGOs (CPAR). Over 10 key informants were interviewed, and four mini case studies conducted. In Mwisi, the District Forest Office, Kabale, was visited where discussions were held with the district forestry officer, an experienced staff in the area (seven years) gave an overview of the general forest and environmental situation in the area. Some of the key informants interviewed were:

- Staff of CPAR
- Tororo LC III Chairperson, Eastern Division
- Tororo Cement Engineer
- NWSC, Tororo Area Manager
- Iganga Town health inspector
- Iganga Town Clerk
- Iganga Town Water Engineer
- Iganga LC III Chairperson
- Kabale District Forest Officer

Venn diagrams: These were used to analyse the roles of the various institutions or key stakeholders (both institutions and individuals) in the provision of water for domestic use.

The other methods used were pie charts, cause-effect diagrams, and flow diagrams.

Secondary data collection: To complement information gathered from PLA exercises, where available and possible, the research team also obtained documents, leaflets, books, and any written information they came across regarding the subject under investigation. These were obtained from organisations, departments, and hospitals, dispensaries, both at district and national levels.

In Alemi, the team visited a local dispensary where information on the commonly suffered diseases was obtained. The team also visited CPAR - a Canadian NGO working in the area in safe water provision, sanitation and environmental protection. A number of issues were discussed and a report of a baseline survey for Apac and Lira districts was obtained.

In Tororo, recorded information was obtained from National Water and Sewerage Corporation, Tororo Cement factory, Tororo Hospital, and one private clinic in town.

In Iganga town, the water supply body gave the research team details of its activities, and conditions of connection. Morbidity data was obtained from Iganga hospital.

3.4.5 Permission and Challenges

The Uganda National Council of Science and Technology gave permission for the study and the support of government officials and local leaders was obtained. An introductory letter was written by the Senior Research Officer to the Chief Administrative Officer (CAO) of each relevant district, explaining the objectives of the study and soliciting the CAO's cooperation and support. In most cases the CAO informed other members of the district offices and introduced the research team to the local councils. The LC1s then introduced the researchers to the local people. Involving members of the LCs in the process helped us to gain the confidence of the community and to make the exercise successful.

A number of logistical problems were encountered including concern for personal safety in the Alemi site in northern Uganda, the unexpectedly high cost of transport and the challenge of gaining access to high income households who were suspicious of our intentions.

Unexpectedly, few purely 'piped' or 'unpiped' sites were found. Thus both piped and unpiped survey forms had to be used for all study sites, except for the Tororo low-density area. In most areas good current maps could not be obtained so old maps and maps of the LCs prepared for the LC elections had to be used.

One field assistant reported an interesting constraint: "In our area, we, of course, had to spend the whole day at the household, a situation that made some men quite uneasy. They assumed that the male field assistant might develop interest in their wives, while others felt having a visitor in the home for a whole day was inconvenient."

3.5 Data Processing and Analysis

On completion of the survey, all forms, site maps and household sketches were checked. A workshop was held in which the field assistants discussed their experiences and planned for a peer review exercise. Field assistants reviewed each other's work - double-checking all the forms, adding missing information, correcting mistakes in calculations and making general comments.

Data were entered into computer using the Statistical Package for Social Scientists (SPSS). The original data from *Drawers of Water I* were also entered in SPSS format. The final database includes information for piped and unpiped households in rural and urban areas for all the three countries (Kenya, Tanzania and Uganda), for DOW I and DOW II and it could be made available for future reference at request. The original interviews are kept in Uganda with copies at IIED in London.

4 Domestic Water Use: Results

4.1 Per Capita Water Use

In 1997, a total of 377 households were surveyed at 11 Uganda sites. The mean per capita water use was 31.0 litres (SD = 35.0) with Mwisi (9.1 litres) and Tororo (110.7 litres) reporting the lowest and highest respectively. In 1967 (DOW1), however, the mean per capita water use was 44.4 (SD =58.6). Mwisi still had the minimum (4.5 litres) and Tororo had the highest (160.9). Overall, there has been a significant decrease in the mean per capita water use between 1967 and 1997 ($F=12.99$; $p<0.001$). The distribution of mean per capita water use in the Uganda sites for 1967 and 1997 is summarised in Figure 4.1.

The most important factor influencing per capita water use was whether or not a particular household had a piped connection. During Drawers of Water I households with piped connections were using an average of 108 lpd, while those without piped connection reported an average of only 12.3 lpd, showing a relation of approximately 1:9, that is, unpiped households used one litre of water for every nine litres used by piped households.

Thirty years later this relation has significantly dropped to approximately 1:4 as a result of two opposite changes. On the one hand, unpiped households increased their water use to almost 18 lpc (44 percent more than their levels during DOW I), on the other hand, piped households experienced a drastic decrease in average water use of 40 percent, from 108 to 64 lpc (Figure 4.2).

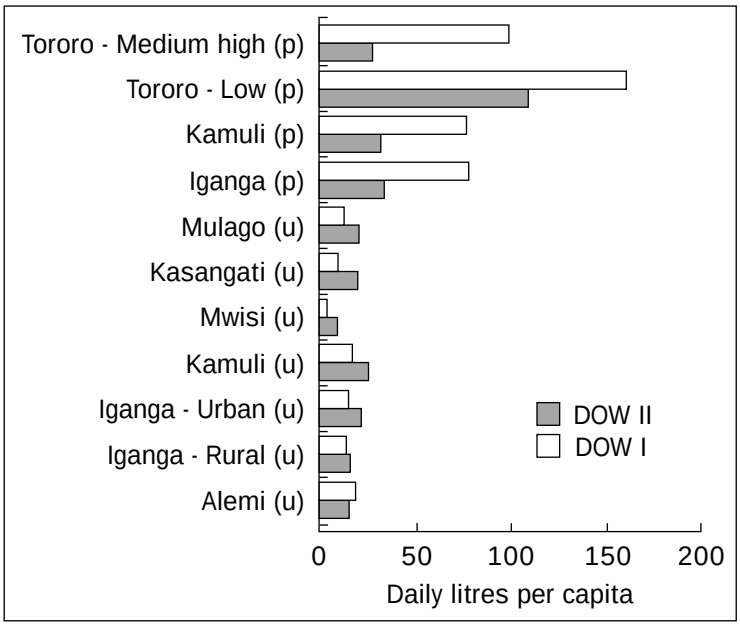


Figure 4.1 Mean Per Capita Water Use, by Site (in Litres)

Note

(u) Site was 100% unpiped during DOW I

(p) Site was 100% piped during DOW I

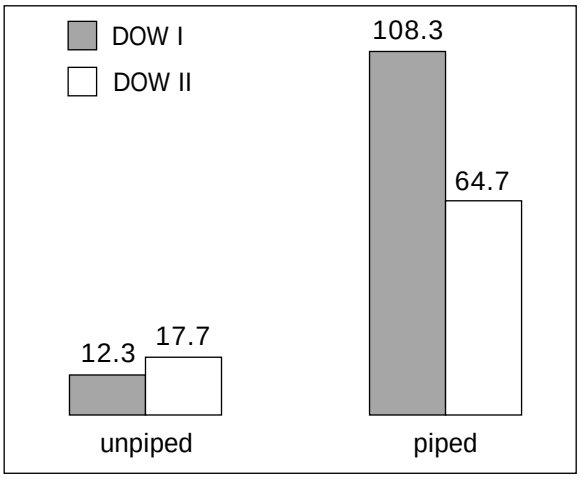


Figure 4.2 Mean Per Capita Water Use, by Type of Connection (in Litres)

4.1.1 Per Capita Water Use in Unpiped Households

A total of 258 unpiped households were surveyed at 10 Ugandan sites in 1997. The mean per capita water use was 17.7 litres (SD =10.1) with Mwisi reporting the lowest (9.1 litres) and Kamuli reporting the highest (25.8 litres) (Figure 4.3). In 1967 (DOW1), the mean per capita water use in unpiped households was 12.3 litres (SD =7.4) while in 1997 (DOWII) it was 18.3 litres (SD = 9.9) and the difference was statistically significant (p=0.000) .

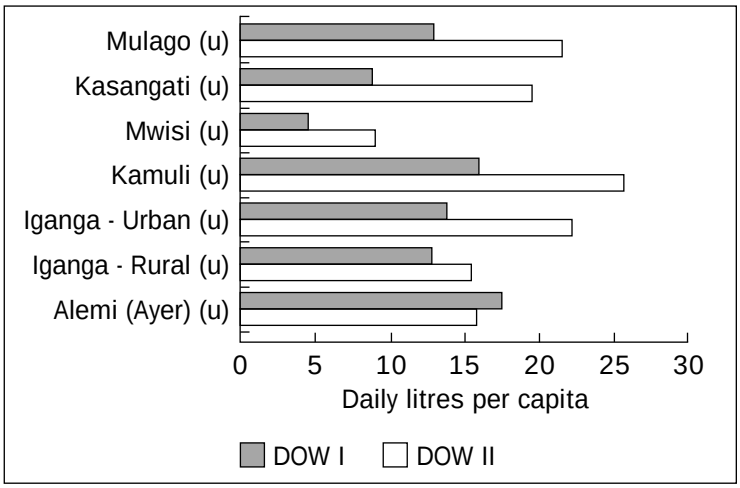


Figure 4.3 Changes in Per Capita Water Use, Unpiped Households, 1967-1997

4.1.2 Per Capita Water Use in Piped Households

In 1997, a total of 119 households with piped connections were surveyed from eight Ugandan sites. The mean per capita water use was 64.7 litres (SD = 54.5) with the lowest being reported in Iganga (16.3 litres) and the highest in Tororo Senior Quarters (110.7 litres.). Only four of these sites were located in sites denominated as 'piped' during *Drawers of Water I* and therefore direct comparisons are based on these sites (Figure 4.4).

Per capita water use in all of the four piped Ugandan sites dropped significantly between 1967 and 1997.

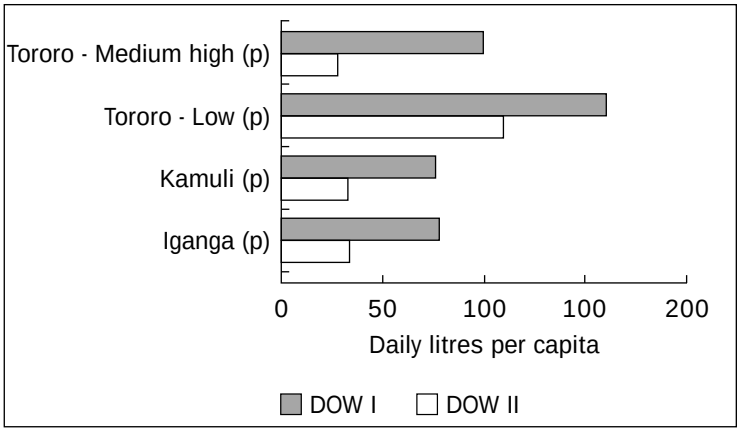


Figure 4.4 Changes in Per Capita Water Use in Piped Households, 1967 and 1997

4.1.3 Per Capita Water Use in Rural and Urban Sites

Nearly all sampled households living in rural areas were unpiped, and only three percent reported piped connections during *Drawers of*

Water II. The situation was more mixed in urban areas, where 63 percent and 48 percent of households showed piped water connections during DOW I and II, respectively.

Unpiped households living in urban areas consistently use more water than those living in rural areas. During DOW I, the average water use was 14.3 lpc in urban areas and only 11.5 in rural areas. During DOW I all households have increased their levels (23.5 and 15 in urban and rural areas, respectively), although the change was more noticeable in urban areas, which experienced an increased of almost 65 percent with respect to their levels during DOW I (Figure 4.5)

Over the 30 years, per capita water use in the urban sites has fallen while that in the rural sites has increased.

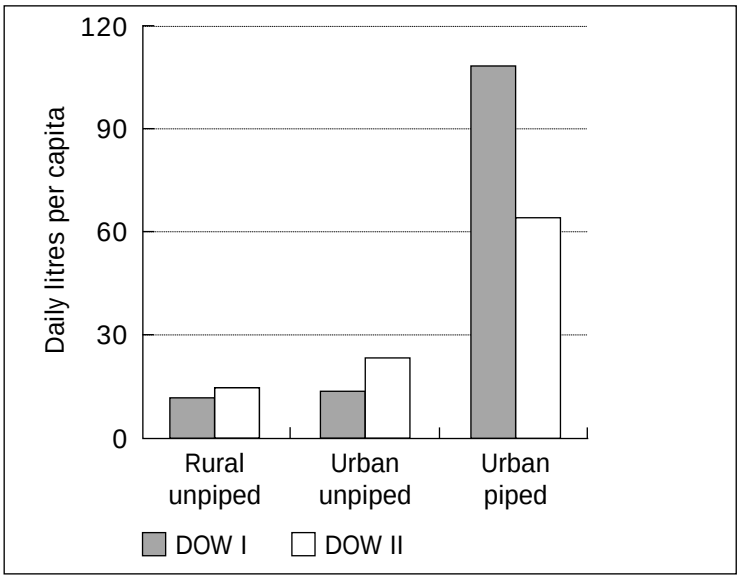


Figure 4.5 Mean per Capita Water Use by Location of Sites, 1967 and 1997

4.2 Specific Uses of Water

In the 1997 study (DOW II), per capita water consumption was broken down into the following uses: toilet flushing, bathing, washing clothes and dishes, gardening, for livestock, business, drinking and cooking. Unfortunately there is no comparable data for 1967.
Figure 4.6 shows the mean per capita water use for the different uses for piped and unpiped households. Overall for the unpiped households the most water intense activities are bathing and washing. However for the piped sites the most water intense activity is toilet flushing.

Table 4.1 presents the mean per capita water use for the different uses for urban and rural households. Overall the situation is similar to that in rural /urban areas except that toilet flushing is not so intense.

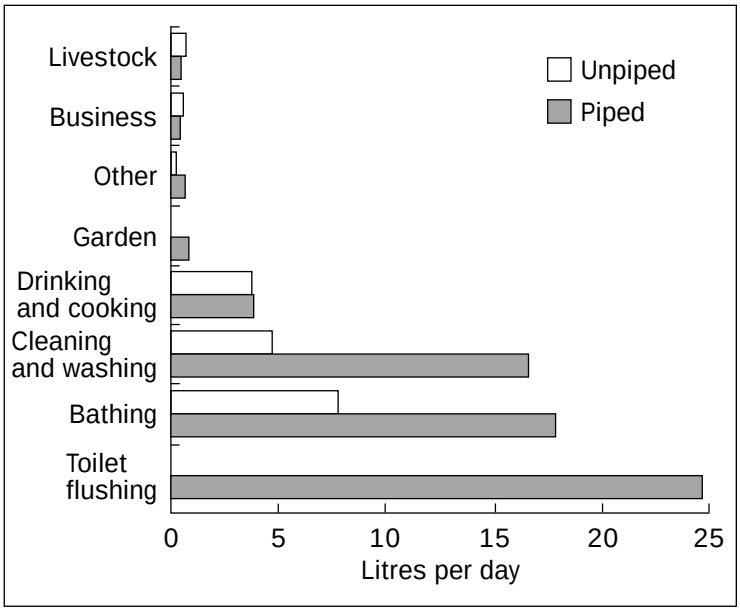


Figure 4.6 Per Capita Water Use by Type of Uses

	Piped Households		Unpiped Households	
	Rural	Urban	Rural	Urban
Drinking and Cooking	3.40	4.08	3.7	4.1
Bathing	22.13	17.66	5.8	10.2
Cleaning and Washing	22.68	16.44	6.3	7.3
Toilet flushing	29.67	24.42	0.0*	0.0*
Business	0.48	0.52	0.02	0.8
Livestock	2.65	0.43	2.6	0.5
Garden	0.34	0.84	0.5	0.1
Other	0.00	0.75	0.2	0.7

Table 4.1 Per Capita Water Use for Specific Uses of Water (Urban-Rural)

* Flush toilets are not commonly used by unpiped households.

5 Determinants of Water Use

Mwisi Take a typical Kiga household in Mwisi. Today the woman walks down hill to the stand pipe (part of the gravity water scheme) and puts her 20-litre jerrycan in the long queue of yellow jerrycans waiting for the first one to fill as she chats with her neighbours about the food shortage. After waiting for more than two hours, the water in the stand pipe runs out so she walks to a spring near the new lush potato gardens in the reclaimed swamps where she collects a jerrycan full of water to supplement another full jerrycan left over from the previous night.

Almost half the water is used for bathing for her two school children, a nine year old boy who uses two litres and a 10 year old girl who uses three litres. The mother used one litre for washing her face in the morning and three litres at 1 p.m. for bathing her two year old girl before taking her to the hospital at Kabale for treatment for malaria. Washing dishes and cooking account for only one third of the water, as there is not much food around to cook. The adults take evening baths using a total of 11 litres which the two school children will carry in the evening after returning from school. As she has no sorghum left in her house, the woman no longer offers obushera, a thin broth made from sorghum flour and water, to her children.

5.1 The drawers of water

In the original study, female adults and children were the main drawers of water. There is still prejudice against men carrying water on their head or back in Alemi. On the rare occasions when men do fetch water, they carry it on bicycles and usually collect it from distant sources. The men's FGDs in Alemi said that they do not allow their women to go to fetch water from some remote sources in case strangers molest them. The Kiga men in Mwisi fetch water for making beer, brick-making, and mud for the construction of houses made of mud and wattle. They do not ordinarily carry water for domestic uses. This task is left to women and children.

A Woman Carrying Water in Alemi

School Girls Carrying Water in Alemi

Alemi In a typical Langi household of eight people, the carrying of water is done by the mother alone. She makes three trips using a 45-litre container (a *sufuria* she received from her in-laws as a wedding present). Today there is no rainwater but she sometimes uses rainwater for bathing the children. It is taboo for other clans in the area to use rainwater collected from the thatched roof, as it is believed the water will cause skin disease.

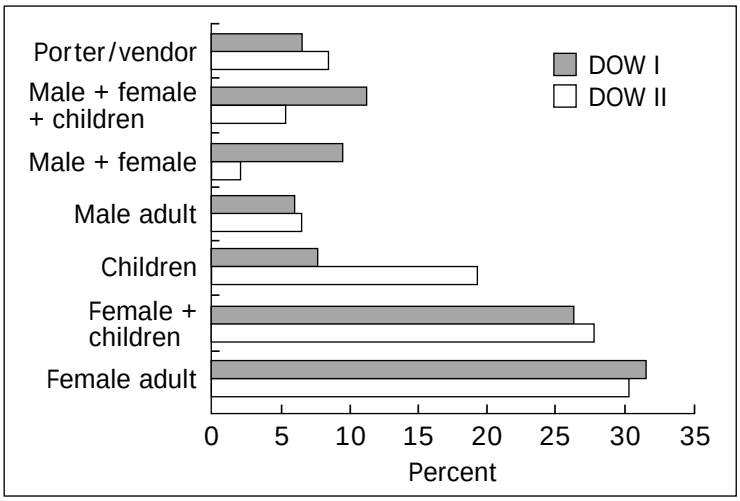
Her main water source, a hole at the edge of the papyrus swamp, from where she draws her water is very deep with a little water at the bottom. She uses a dried gourd to scoop out the water from this water hole, a practice her mother and grandmother were observed following during DOW I. It takes almost 30 minutes to scoop out enough water from the water hole to fill her *sufuria*.

Bathing during the morning and evening accounts for almost 40 percent of the water used although boys and young men usually bathe at the water source in the evenings. The next largest volume is used for cooking, followed by drinking. During the study there was fresh maize in the gardens and the people would roast a lot of maize which made them very thirsty, necessitating drinking large volumes of water.

During *Drawers of Water I*, children accounted for only eight percent of the water collectors while in *Drawers of Water II* they accounted for 19 percent of the water collectors. There has not been a significant change in the role played by vendors. They accounted for only seven percent in DOWI and nine percent in DOWII (Figure 5.1).

A Young Male Vendor Delivering Water by Bicycle

Figure 5.1 Drawers of Water Among Unpiped Households 1967 Vs 1997



In most cases, water vendors are young men or male teenagers. Some women are employed by water committees or private owners of boreholes or kiosks to sell water in Iganga, Kamuli and Mulago. However, no woman or girls carrying water for sale were encountered during the fieldwork.

In Alemi both women and men's FGDs believed that it was the women's duty to fetch water. The women said: "*Don't you know that it is our duty and responsibility in the Lango culture to fetch water? Men rarely fetch water in this community*". They claimed however that men might fetch water under certain conditions:

- When the wife has gone somewhere far for a visit;
- When the wife is ill;
- When she has other heavy agricultural activities such as weeding, planting, harvesting beans and *sim sim*, groundnuts, millet and cotton;
- When the distance to the water source is too long the man may fetch water for her (on a bicycle). However this is not common;
- When there are very many visitors at home.

However, old men rarely fetch water. In fact one said: "*People will wonder why Mzee is carrying water.*" Unmarried men and widowers also fetch water for themselves, especially if they are living alone in

their own houses. Recently some young men, including born-again Christians in the area, have started collecting water as a sign of good relationship with their newly married wives.

The men said, *"It is automatic that the women have to fetch water, weed and harvest the crops, collect firewood and cook for the family"*. When asked whether there was any automatic work for a man, the men cited:

- Provision of peace and security;
- Ensuring food security and opening up the land by ploughing;
- Ensuring shelter;
- Payment of children's school fees.

Even amongst women within one household, children and young women fetch the bulk of the water. Newly married women were expected to draw water for their in-laws, but the situation seems to be changing in Alemi and the elders are not very happy with it: *"The newly married women these days refuse to fetch water for their in-laws because they are liberated. They say they also have their own family work"*.

However, the elders are not happy about this change and in fact some of them believe that the daughter-in- law who refuses to fetch water for them *"may be was not brought up well"*. It seems that the elders have had to accept the change, albeit reluctantly, as exemplified by this statement from one of the male elders in Alege village: *"I look for my grand son or grand daughter to fetch for me water and leave my in-laws alone"*.

In the past, the elders would consult the husband about the issue and if the daughter-in-law did not reform she would be reported to clan leaders for warning, and if she did not change, this could lead to a divorce.

The young husbands were also expected to coerce their wives to fetch water for the in-laws but these days they do not. They claimed that this was in response to government policy on the rights of women. However, one old man claimed that: *"The sensitisation and government policy has destroyed our culture – young women do not respond to our culture any more"*.

However, in the women's FGDs the women said that the main reason for the changes (daughters-in-law not fetching water for their in-laws) was the development of young couples having their own separate households thus making them independent of the in-laws. The young women however said that once in a while they assist their in-laws to fetch water, otherwise *"the in-laws have to find their own means of fetching water themselves"*.

When there is a helpless destitute in-law, the son might shift this helpless person to his home where the person can get assistance including *"using the water fetched by the daughters-in-law indirectly"*.

5.2 Principal Water Sources

When a household does not have piped water supplied to their homes, they must rely on other sources to obtain water. Unpiped sources range from springs and streams, to standpipes or water supplied directly to the household at a charge from vendors. Broadly speaking, sources can be divided into three categories:

- *Unprotected sources* such as springs, seeps, streams, rivers and lakes
- *Protected sources* such as wells, standpipes and hydrants
- *Other sources* such as vendors, kiosks, piped to building, neighbourhood resale

Although the water was not tested during the fieldwork, sources are evidently of variable quality, ranging from the contaminated seeps in Alemi, the unprotected springs in rural Iganga (Site 24), to the protected springs in Mwisi.

In rural Iganga there are a lot of unimproved contaminated water sources. This is illustrated by the photo showing one such source, which comprises a pool of water, surrounded by shrubs. The surrounding bush is occasionally used as a toilet by the neighbouring households.

A Contaminated Water Source in Iganga

In general, protected and other sources tend to be the better alternatives in terms of quality, reliability and accessibility. However, each category has advantages and disadvantages. Unprotected sources tend to be the most seasonal, leaving households prone to shortages at some times in the year. In addition, they are open to contamination and therefore carry health risks. Prone to technical failure, protected sources can also be unreliable. Moreover, they are often used by a large number of households and tend to involve considerable time waiting at water points to collect water. Private sources such as vendors and kiosks while reliable and generally of better quality tend to be the most expensive in monetary terms.

Drawing on these relative advantages, households may rely on more than one source to satisfy their needs, often differentiating between sources for different uses. For example, households may obtain water for cleaning the house and washing clothes from a nearby lake or stream but rely on vendors or other piped sources for drinking water. In the former case, the water may be brought back to the house or the task performed at the source.

Results. The average number of water sources used by unpiped households in rural areas has significantly increased since DOW I (1.7 versus 3.2). Unpiped households in urban areas had a wider range of water sources (2.4 and 3.9 during DOW I and II, respectively).

Rural households depended largely on surface sources (Figure 5.2). During DOW I, 45 percent of unpiped households were using mainly springs and seeps as their primary source, while wells were used by 39 percent of households. During DOW II the dependence on these surface – unprotected – sources had significantly increased to almost 80 percent, as many of the existing wells and improved facilities broke down.

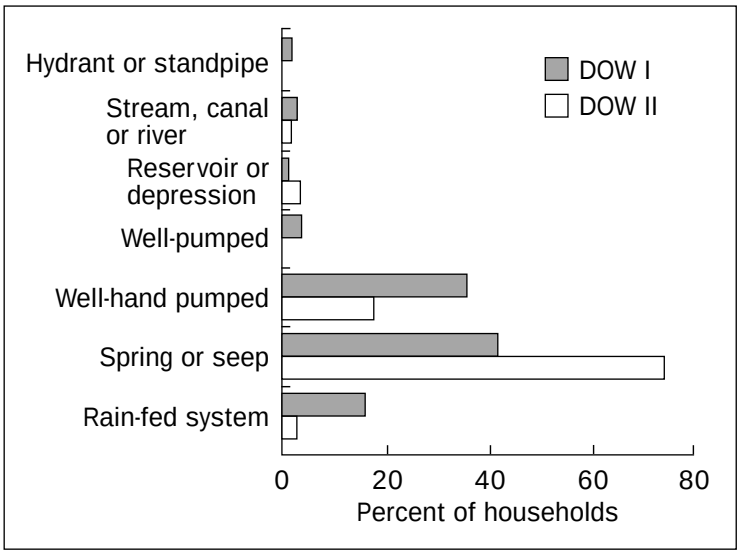


Figure 5.2 Principal water source for unpiped households in rural areas (DOW I and II)

Note only same sites as DOW I are compared

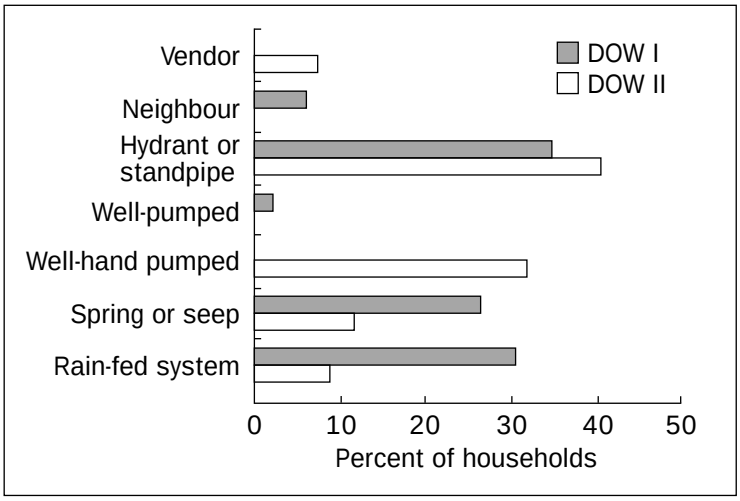


Figure 5.3 Principal water source for unpiped households in urban areas (DOW I and II)

Note only same sites as DOW I are compared

The majority of unpiped households living in urban areas have access to improved water sources (Figure 5.3), especially hydrants or standpipes and wells. Vendors are used as a water source by seven percent of households, located mainly in Iganga and Mulago. The use of private water sources, such as vendors and kiosks, is more evident for unpiped households living in sites that were piped during DOW I (Figure 5.4). Most of these households are located in Iganga, in areas densely populated.

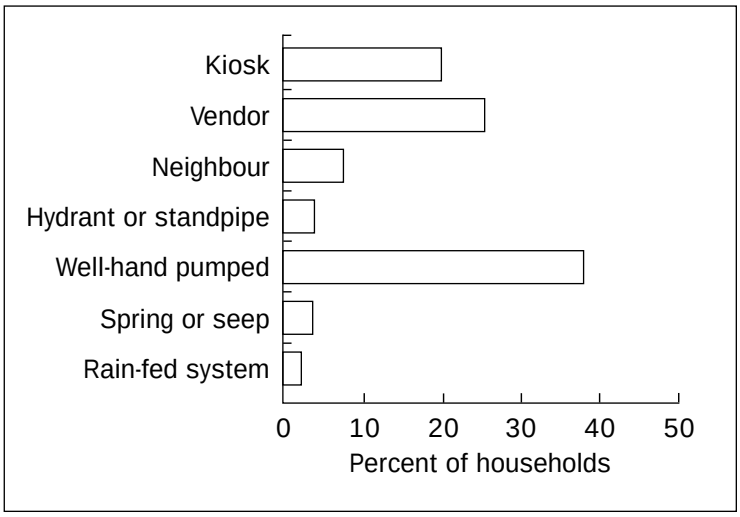


Figure 5.4 Principal water source for 'newly unpiped' households in urban areas (DOW II)

Note *'Newly unpiped' are unpiped households living in sites considered as piped during DOW I.

5.3 Technological Factors

5.3.1 Size and Type of Container for Water Collection

The 15-19 litre tin (*debe*) observed in 59.4 percent of the 165 households in DOW I, is now "extinct" to use the word of one of our informants. It has been replaced by the ubiquitous plastic 20-24 litre jerrycan observed in 91.2 percent of 238 households in DOW II (Table 5.5 and Figures 5.7 and 5.8). Furthermore, there is no significant difference between the size of water collection container used in the rural and urban unpiped households.

Table 5.1 Size of Vessels Used for Water Collection, 1967-1997 (percent of Households)

	DOW I	DOW II
Less than 5 litres	0.6	2.1
5-9 litres	5.5	0.0
10-14 litres	13.3	4.6
15-19 litres	59.4	1.3
20-24 litres	3.0	91.2
25-29 litres	0.6	0.4
30-34 litres	1.8	0.4
35-39 litres	2.4	0.0
40 litres or more	13.3	0.0
Total	**100**	**100**

Queueing for Water with Jerrycans, in Iganga

Collecting Water with Jerrycans in Mulago

5.3.2 Modes of Transport Used to Collect Water

Figure 5.5 gives a breakdown of the modes of transport used to collect water by unpiped households. Clearly, the vast majority (84 percent) of drawers of water walk to the water source while only a handful use bicycle or hand drawn carts.

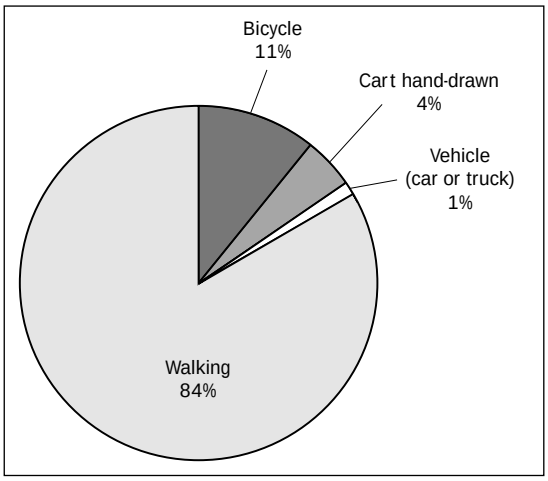


Figure 5.5 Mode of transport to the main water source, 1997

5.3.3 Water storage

Unpiped households: In DOW I only 46.7 percent of the 167 unpiped households were storing water whereas 85 percent of the 260 unpiped households in DOW II were storing water.

Of the 118 rural unpiped households in DOW I, just more than half (51.1 percent) were storing water compared to 81.5 percent of the 135 rural unpiped households in DOW II.

There has been a dramatic increase in the number of unpiped households storing water in the urban areas from 26.5 percent (13) of the urban unpiped households in DOW I to 90.4 percent (113) of the unpiped households in DOW II.

Piped households: The increase in the proportion of households storing water is even more dramatic amongst those with piped water connections. Whereas only one (1.2 percent) of the piped households was storing water in DOW I, 86.6 percent (103) of the piped households were storing water in 1997 DOW II.

5.4 Water Supply Services

Water supply services have broken down since *Drawers of Water I*, when all households in the survey received 24 hour supply service and paid proportional rates according to consumption. Thirty years

later the service situation is highly variable. The most common method of payment was still a proportional rate (86 percent), where most households still receive continuous water supply (for example in Tororo piped households have water supply available for 24 hours).

However, block or flat rates were paid by 18 percent of households (especially in Iganga and Kamuli, some of which could pay approximately US$12/month fixed rate), and the water service in these areas is appalling. Fifty percent of households receive one to five hours of water per day, 40 percent of households receive six to 11 hours of water service, and only five percent of households receive a continuous 24-hour supply (Table 5.2). As a consequence of this situation the water consumption is much lower in these areas (32 lpc) compared to sites paying proportional rates (66 lpc).

Table 5.2 Number of hours of water services according to type of water rate (DOW II)

Note all households during DOW I received 24-hour service

Water service hours (day)	Type of water rate (percent of households)	
	Block / flat	Proportional
1-5 hours	50	4.6
6-11 hours	40	8.0
12 hours	5	1.1
24 hours	5	86.2
Total	**100%**	**100%**

In Iganga, for example, the FGDs said that water from Iganga town council supply was only available four hours per day (two hours in the morning and two in the evening). However during electric power shading, or in case of mechanical problems, no water is supplied. The deterioration in service levels in Iganga had taken several decades to develop as shown by this statement from one of our key informants:

"During the 1960s and early the 1970s, the situation was good but starting from the late 70s, the supply of water started deteriorating and the situation worsened in the 1980s. Water pumps and most of the distribution lines broke down. Out of the four pumps, which were operational in the 1960s, only one was functional by 1980."

At the time of the study, the situation had improved due to some repairs made but the major problem now is with water metres. Apparently the

situation in the 1980s was so bad that women would spend the whole day walking long distances in search of water. Some families would employ someone specifically to look for water. According to the men's FGD, in the 1960s the flow of piped water was regular and on a 24-hour basis.

5.5 Direct and Social Cost of Water

5.5.1 Piped Households

The average cost of water has increased slightly since DOW I, when the average cost of water was US$0.81 compared to US$0.804 during DOW II (0.74 and 0.75 Uganda shillings, respectively)[16]. At site level, Tororo (medium high) and Iganga experienced a small reduction in cost of water, while cost in Kamuli increased more than 70 percent compared to DOW I, with households reporting values as high as US$4 per cubic metre. Three sites that had been classified as 'unpiped' during DOW I (Iganga-rural, Kamuli-unpiped and Mulago) reported an average cost of water of US$0.78, with Kamuli showing the highest cost at US$2 pcm (Figure 5.6).

16 Since the original *Drawers of Water I* the economy of Uganda has undergone severe inflationary pressures and periods of economic instability. Obtaining the necessary national deflator was extremely difficult, and to overcome this situation the team decided to use the US Dollar deflator. Despite the limitations of this approach, it was decided that it would be most reliable until better indicators are obtained.

5.5.2 Unpiped Households

5.5.2.1 Deriving a methodology for comparison

The nature and complexity of the costs faced by both piped and unpiped urban households in obtaining water differ greatly. Households with piped water supply simply pay a fee to the service

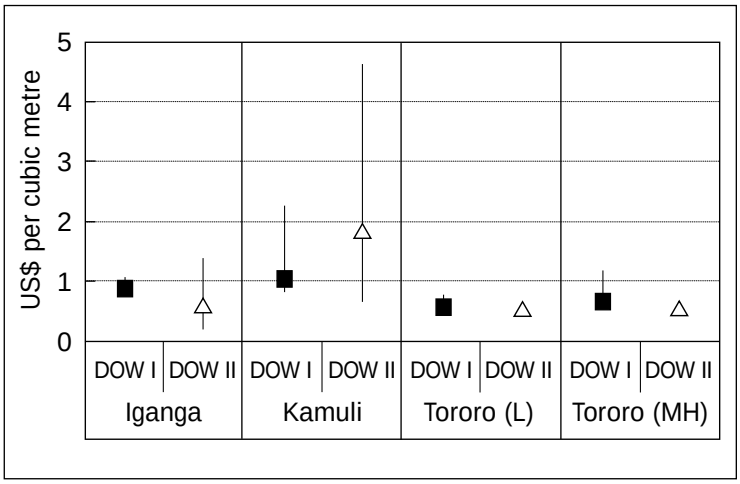


Figure 5.6 Change in cost of water for piped households (DOW I-DOW II)

provider, which could be a block or flat rate, a proportional rate (according to consumption), or a residential rate.

Estimating the cost of water is a more complex situation for households without piped connections. It usually involves a direct cash price paid at the source, as well as the time and energy expended in travelling to and from the source, queuing for water and carrying it home. In addition, there is the opportunity cost of activities that individuals could be doing if they were not collecting water that could be as much as two hours per day for those drawers collecting water from kiosks.

Converting these costs into a comparable cash value is difficult. In the original *Drawers of Water*, a cash value was derived by estimating the amount of energy used by each household, determining the amount of a staple food (maize) required to supply this energy and then calculating the price required to purchase that amount of food. White, Bradley and White referred to this as the 'social cost of obtaining water'.

Energy expenditure was estimated based on previous estimates from other studies on African people approximately the same size of East Africans. Table 5.3 presents an estimation of the calories per hour used to walk to the source (with empty buckets), waiting at the source to collect the water, and coming back home carrying loads of different weights (14, 20 and 40 kg). Special graphs were prepared for field interviewers to make quick calculations of total amount of calories per trip.

Table 5.3 Calories used per hour in collecting water

Source Adapted from White, Bradley and White (1972)

	Walking at approx. 2.5 mph (3.5 C/K/hr)	**Sitting or standing** (1.5 C/K/hr)	**Carrying loads of:**		
			14 kg (3.7 C/K/hr	**20 kg** (3.9 C/K/hr)	**40 kg** (4.9 C/K/hr) for woman)
	C/hr	C/hr	C/hr	C/hr	C/hr
Man (58 kg)	203	87	215	226	-
Woman (54 kg)	189	81	200	211	265
Child (25 kg)	88	38	93	98	-

The other factor that contributes to energy expenditure is the gradient of land surface. More energy is required to walk uphill, especially when carrying a heavy load; and although less energy is needed to walk downhill, additional energy is needed to keep the body upright while descending a very steep slope. To overcome this issue, the original

Drawers of Water used a table of slope factors, based on previous studies, and the energy expenditure was multiplied by the factor appropriate to the gradient to and from the source (Table 5.4).

Gradient (degrees)	Slope factor	
	Uphill	Downhill
0-2.5	x 1	x 1.0
2.6-5.0	x 2	x 0.8
5.1-7.5	x 3	x 0.7
4.6-10.0	x 4	x 0.6
10.1-12.5	x 5	x 0.9
12.6-15.0	x 6	x 1.0

Table 5.4 Allowances made for gradient in calculating energy expenditures

Source White, Bradley and White (1972)

Finally, one gram of maize meal, yielding 3.5 Calories, was used as the unit of food to provide the energy requirements. Maize was, and still is, the basic staple in East Africa, used as food or beer in the diet of farmers and people living in towns. It is also one of the cheaper foods, which is appropriate in the study to avoid overestimation of costs. This method has been repeated for *Drawers of Water II* to enable direct comparison of the cost of water for piped and unpiped households and the assessment of how the cost of water has changed over the past three decades.[17] It is important to recall that while this measure might not be directly comparable with other values estimated in different studies, it still is a very useful tool to enable direct comparisons of how the cost has varied since the first *Drawers of Water* study.

17 The methodology developed by Drawers of Water I to estimate the cash price of water for unpiped households has a number of shortcomings, making its reliability problematic. For example, the opportunity cost of time is not included, and the use of the average price of staple food masks seasonal and inter-household variation.

5.5.2.2 Distance, time and calories

In general, although distance to the source slightly decreased since DOW I, return time increased 47 percent (from 11 to 16 minutes) and consequently the energy expenditure also increased an equivalent of 83 percent (from 117 to 215 calories).

Distance. Unpiped households living in rural areas are located farther away from their water sources than those living in urban areas. As Figure 5.7 shows, during DOW I rural households walked nearly twice as much as their urban counterparts (344 m compared to 177 metres).

Thirty years later average national figures show a slight decrease in distance to the source (nine percent, from 300 to 272 metres). This situation is mostly due to a 12 percent decrease in distance in urban

areas, but masks an increase of 10 percent in distance in rural areas, where as previous water sourced dry up, households are forced to walk longer distances to fetch water. The gap between rural and urban has increased: rural households walk two and a half more than urban households to get water.

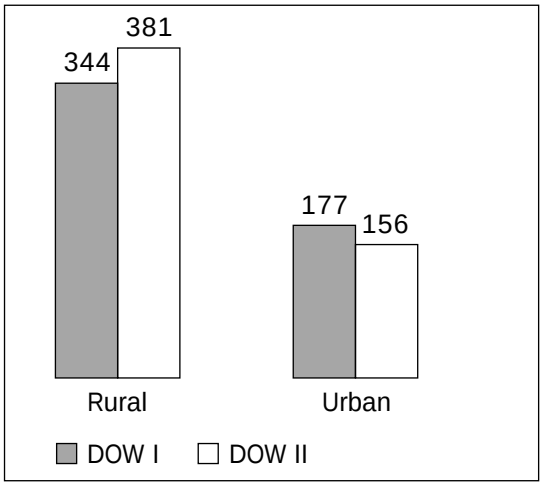


Figure 5.7 Distance to the source (metres)

Kamuli
In the unpiped, urban site of Kamuli, a number of the seeps/springs and swamps which existed during DOW I have dried up. For example, the seep/spring that was found off the Jinja Road in DOW I, was not found in DOW II. The swamp found in the valley off Namwendwa Road, about 300 metres from Source 103 of the current study, is also now non-existent. The drying up of sources is largely due to the reclamation of wetlands for agriculture, and neglect of the springs where people prefer borehole to spring water. In this area, most households do not have access to piped water and water sources are quite a distance away. Thus households in this area tend to economise the little water they manage to draw from such long distances. People around the Kamuli Mission Hospital draw water from the mission boreholes free of charge.

Time to the source. Despite the fact that distance slightly decrease in urban areas, return time to the source increased since DOW I regardless of geographical location (Figure 5.8). This situation is particularly acute in urban areas, where over-crowded water supplies result in longer waiting times at the source. Return time in these urban sites has doubled from six to 13 minutes, especially in Kamuli and Iganga.

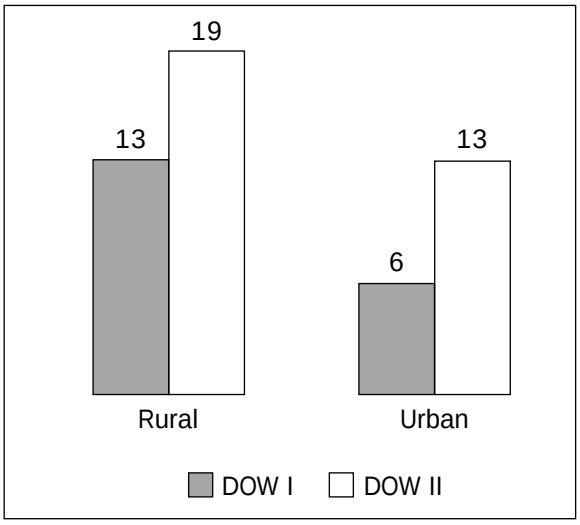


Figure 5.8 Return time to the source

Rural areas have also experienced substantial increases in time to the source, from 13 to 19 minutes, and it is particularly high in Alemi, where households require on average 25 minutes per trip (with reported maximum of 67 minutes). Increases in time spent looking for water has a significant negative effect on the well-being of the family, as the women have less time to dedicate to crops and other domestic shores.

Energy requirements. The energy requirements to fetch water were calculated based on time to the source, gender and age of the drawer of water, and degree of hill slope (see Section 5.5.2.1 for a description of calculation methodology). During the DOW II study results show that, on average, a person fetching water requires 50 calories per trip. Calorie requirements are higher in rural areas, where sources are farther away (65 calories compared to 29 in urban sites). The calories per trip have slightly decreased since DOW I, when households required approximately 69 and 30 calories in rural and urban areas, respectively.

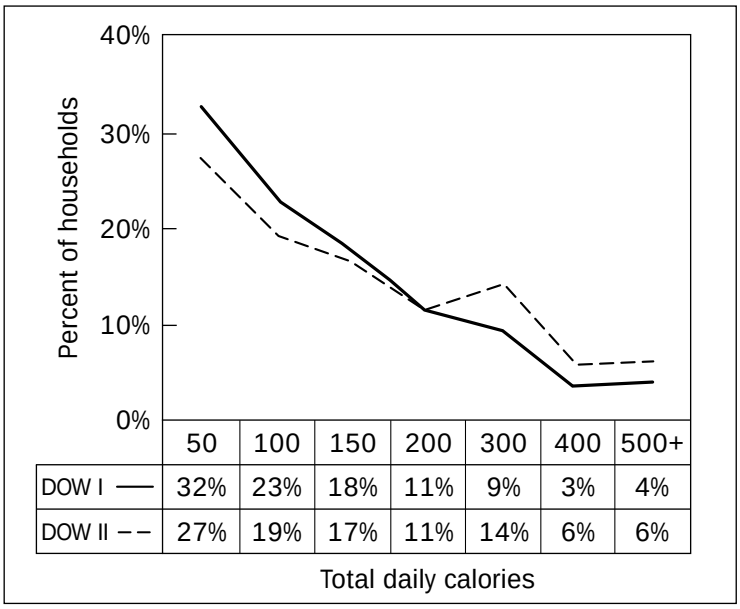
The total daily energy expenditure (calories per trip X number of trips) has substantially increased since DOW I, due to the increase in number of trips to the source necessary to cater for the increase in water use (Figure 4.3), from an average of 117 to 176 calories per day.

		Calories per trip		Daily Total Carrying Cost	
		Mean	**Range**	**Mean**	**Range**
DOW I	Rural	69	0-272	136	0-704
	Urban	30	5-77	64	0-308
	Total	**60**	**0-272**	**117**	**0-704**
DOW II	Rural	65	1-225	217	2-1151
	Urban	29	0-212	129	0-1723
	Total	**49**	**0-225**	**176**	**0-1723**

Table 5.5 Energy requirements for unpiped households: rural and urban sites

The range of energy requirements has also increased, from 0-704 during DOW I to 0-1723 during DOW II. Figure 5.9 presents energy requirements reported by households in both samples. Most of the observations are concentrated for values of 200 calories or less, and fewer households report values of 300 or more calories per day, although approximately five percent of households reported values of 500 or more calories (four percent in DOW I and six percent in DOW II).

Figure 5.9 Total daily energy requirements (calories)



5.5.2.3 A cash value for water

Following the methodology described in the previous section, the caloric cost was transformed into a cash equivalent by estimating the amount of maize (as staple food) necessary to supply the energy requirements. The cost of water when supplied from a vendor is the direct monetary payment to the vendor.

The results, shown in Table 5.6, indicate that the cost of water has more than doubled since DOW I, increasing from an average of US$0.6 to US$1.3 pcm. This value is equivalent to an increase from 10 Ugandan shillings per jerry can during DOW I to 24 Ugandan shillings during DOW II. Cost of water was consistently lowest in rural areas, although it increased 30 percent since DOW I (from 10 to 13 shillings per jerry can).

Table 5.6 Cost of water for unpiped households (DOW I & II)

Note SS corresponds to 'same sites' as DOW I. 'New Urban' corresponds to unpiped households living in urban sites that were piped during DOW I.

	US Dollars (1997) pcm	Uganda shillings per litre	Uganda shillings per jerry can
DOW I			
SS Rural Unpiped	0.5	0.5	10
SS Urban Unpiped	0.7	0.6	13
Total	**0.6**	**0.5**	**10**
DOW II			
New Urban Unpiped	2.5	2.3	46
SS Rural Unpiped	0.7	0.7	13
SS Urban Unpiped	1.5	1.3	27
Total	**1.3**	**1.2**	**24**

5.6 Multivariate Regression Analysis

5.6.1 Water Use in Unpiped Households

The socioeconomic factors influencing per capita water use in the unpiped households were studied using multiple regression to determine which ones were significant and to show how they vary with water use. Two models were developed:

Model 0 1 Unpiped: The dependent variable to estimate in the model is per capita water for all uses in litres.

- Independent Variables
- Site is urban – dummy: 1 = Yes, 0 = No.
- Number of people in household
- Proportion of children in household
- Proportion of females on household
- Equipment index
- Highest education level in household
- Household head is a farmer – dummy: 1 =Yes, 0 = No.
- Household head is an artisan/business person – dummy: 1 = Yes, 0 = No
- Household uses water for gardening – dummy: 1 = Yes, 2 = No
- Household uses water for livestock – dummy: 1 = Yes, 2 = No
- Household uses rain water sometime in the year – dummy: 1 = Yes, 2 = No
- Distance to source – return journey in kilometres

Descriptive statistics of the variables are presented in Table 10.1 in the Appendix Section. The correlation between observed and predicated values of the dependent variable, (R^2), once adjusted for by degrees of freedom is 0.46. The ANOVA test rejects the joint hypothesis that all the coefficients are zero (F=17.8, p=0.000). Table 5.7 presents the regression results.

Table 5.7 Model 01 Unpiped. Estimated Coefficients

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. error	Beta	t	Sig.
(Constant)	15.543	2.627		5.917	.000
Site is Urban - Dummy	7.370	1.312	.380	5.616	.000
Number of People in Household	–1.034	.163	–.362	-6.325	.000
Proportion of Children in Household	–8.424	2.354	–.197	–3.579	.000
Proportion of Females in Household	5.317	2.464	.110	2.158	.032
Equipment Index - Standard of Living	.776	.205	.247	3.782	.000
Highest Educational Level in Household	.036	.147	.015	.242	.809
Household Head is a Farmer	1.445	1.445	.073	1.000	.318
Household Head is a Business Person / Artisan - Dummy	4.305	1.310	.182	3.285	.001
Household uses Water for Gardening - Dummy	–.217	1.968	–.005	–.110	.912
Household uses Water for Livestock - Dummy	6.321	1.412	.227	4.476	.000
Household uses Rainwater during the Year - Dummy	–2.958	1.115	–.132	–2.654	.009
Distance to Source - Return Journey (weighted average, all sources)	.004	.002	.117	2.114	.036

Results show that 10 of 13 variables studied are statistically significant. The variables site is urban, proportion of females in household, household head is a business person, equipment index, distance to source –return journey, and household uses water for livestock had a significant positive effect with per capita water use in households. However, the number of people in the household, proportion of children and household use rainwater during the year, showed a significant negative effect with per capita water use. Residual statistics are shown in Table 11.2 in the Appendix.

Model 02 Unpiped (Using Logarithms). The same factors as used in Model 01 were used except that we have used the natural logarithms in per capita water use, number of household members, highest education in the household, equipment index and weighted distance to source. The descriptive statistics are shown in Table 10.3. The correlation between observed and predicated values of the dependent variable (R^2), once adjusted for by degrees of freedom is 0.50. The ANOVA test rejects the joint hypothesis that all the coefficients are zero (F=18.3, p=0.000). Table 5.8 presents the regression results.

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. error	Beta	t	Sig.
(Constant)	2.701	.217		12.426	.000
Site is Urban - Dummy	.372	.067	.374	5.510	.000
Proportion of Children in Household	–.110	.135	–.049	–.816	.416
Proportion of Females in Household	.053	.135	.021	.392	.696
Household Head is a Farmer - Dummy	.007	.072	.007	.097	.923
Household Head is a Business Person / Artisan - Dummy	.134	.071	.104	1.885	.061
Household uses Water for Gardening - Dummy	.003	.100	.001	.028	.977
Household uses Water for Livestock - Dummy	.365	.073	.260	5.033	.000
Household uses Rainwater during the Year - Dummy	–.233	.059	–.203	–3.970	.000
Number of People in the Household (Log)	–.409	.060	–.418	–6.820	.000
Weighted Distance to Source, in Metres	.030	.025	.067	1.197	.233
Highest Education Level in Household (Log)	–.014	.059	–.014	–.231	.818
Equipment Index (Log)	.339	.063	.338	5.398	.000

Table 5.8 Model 02 Unpiped. Estimated Coefficients

Results show that only seven of 13 variables studied are statistically significant. The variables site is urban, household head is a business person, log of equipment index, and household uses water for livestock had a significant positive effect with log of per capita water use in households. While number of log of people in the household and household uses rainwater during the year, showed a significant negative effect with log per capita water use. The residual statistics are shown in Table 10.4 in the Appendix.

5.6.2 Water Use in Piped Households

The socioeconomic factors influencing per capita water use in the piped households were studied using multiple regression to determine which ones were significant and to show how they vary with per capita water use. Two models were developed:

Model 03 Piped. The dependent variable to estimate in the model is per capita water for all uses in litres.

- Independent Variables
- Site is urban – dummy: 1 = Yes, 0 = No.
- Number of people in household
- Proportion of children in household

- Proportion of females on household
- Wealth index
- Highest education level in household
- Household head is a farmer – dummy: 1 = Yes, 0 = No.
- Household head is an artisan/business person – dummy: 1 = Yes, 0 = No
- Household uses water for gardening – dummy: 1 = Yes, 2 = No
- Household uses water for livestock – dummy: 1 = Yes, 2 = No
- Household uses rain water sometime in the year – dummy: 1 = Yes, 2 = No
- Number of taps in households.
- Hours of water service
- Household has electricity
- Household has electricity

Descriptive statistics of this can be seen in Table 10.5. The correlation between observed and predicated values of the dependent variable (R^2), once adjusted for by degrees of freedom is 0.59. The ANOVA test rejects the joint hypothesis that all the coefficients are zero (F=13.5, p=0.000). Regression results are presented below.

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. error	Beta	t	Sig.
(Constant)	53.922	43.543		1.238	.219
Site Located in an Urban Area - Dummy	13.038	29.928	.033	.436	.664
Number of People in Household	–2.230	.963	–.167	–2.316	.023
Proportion of Children in Household	–57.519	16.340	–.252	–3.520	.001
Proportion of Females in Household	37.485	17.904	.145	2.094	.039
Household has Electricity - Dummy	3.215	12.519	0.18	.257	.798
Wealth Index of Piped Households	.032	2.903	.001	.011	.991
Highest Education Level in Household	–1.015	1.497	–.051	–.678	.499
Cost per Litre for Piped Source (Shillings and Cents)	–7.069	4.760	–.107	–1.485	.141
Household uses Water for Gardening - Dummy	72.860	9.579	.631	7.607	.000
Household uses Water for Livestock - Dummy	12.919	9.146	.098	1.412	.161
Number of Taps in Household	1.127	2.424	.039	.465	.643
Daily Number of Water Service Hours	–.705	4.426	–.015	–.159	.874

Table 5.9 Model 03 Piped. Estimated Coefficients

Note Valid sample size N=107

Results show that only four of the 13 factors studied showed a significant influence on the per capita water use among households. These

included number of people in the household, proportion of females, proportion of children and household uses water for gardening. Note that the constant is not also significant. Residual statistics are shown in Table 10.6 in the Appendix. The normal probability plot shows that the residuals are not normally distributed in this model and therefore the model was adjusted by using logarithms (next model).

Model 04 Piped (logarithms). The same factors as used in Model 03 Piped were studied except that we have used the natural logarithms in per capita water use, number of household members, highest education in the household, wealth index, hours of water service, cost per litre of water and number of taps in the households. The descriptive statistics are shown in Table 11.7.

The correlation between observed and predicated values of the dependent variable (R^2), once adjusted for by degrees of freedom is 0.63. The ANOVA test rejects the joint hypothesis that all the coefficients are zero (F=16.0, p=0.000). Table 5.10 presents the regression results.

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. error	Beta	t	Sig.
(Constant)	2.922	1.096		2.667	.009
Number of People in the Household (Log)	–.336	.123	–.210	–2.739	.008
Proportion of Children in Household	–.486	.278	–.133	–1.745	.085
Proportion of Females in Household	.502	.287	.118	1.751	.084
Household has Electricity - Dummy	.138	.196	.051	.707	.481
Wealth Index (Log)	.071	.451	.016	.157	.875
Highest Education Level in Household (Log)	.209	.257	.058	.814	.418
Cost per Litre in US Cents (Log)	.018	.150	.010	.123	.903
Household uses Water for Gardening - Dummy	1.045	.153	.565	6.826	.000
Household uses Water for Livestock - Dummy	.357	.149	.167	2.392	.019
Number of Taps in Household (Log)	.179	.109	.133	1.638	.105
Hours of Water Service (Log)	–.034	.167	–.019	–.203	.840

Table 5.10 Model 04 Piped. Estimated Coefficients

Analysis of the coefficients shows that only four variables (constant inclusive) have a significant effect on the log of per capita water use. These include number of people in the household; household uses water for gardening and livestock. The normal probability plot shows that the residuals are approximately normally distributed. Residual statistics are shown in Table 11.8 in the Appendix.

6 Institutional Factors

6.1 The Role of the Public Sector

The public sector is still active in the provision of water supply in some of the sites studied, through the National Water and Sewerage Corporation and the Directorate of Water Development. For example, in Tororo the National Water and Sewerage Corporation supplies water to the town from its water treatment works on the Malaba River at the Kenya-Uganda border. The water supply in Tororo is well organised, fairly reliable and the customers are, by and large, satisfied. There is no water rationing and every household in Senior Quarters has a water meter. During the PRA exercise it was discovered that water supply from the Tororo NWSC is greater than demand, because the original water works installation capacity was meant to cater for industrial complexes many of which had ceased production. There has been considerable investment by government and donors (through the Seven Towns Water project) in Tororo and this has improved the quality and quantity of water.

In the 1996/97 financial year, about 200km of transmission and distribution pipelines were installed and commissioned in Kampala. Also in Kampala, installation of three new reservoirs, rehabilitation of 65km of secondary distribution network, and expansion and rehabilitation of sewerage facilities was undertaken in the same year. Now the water supply can meet the demand of up to two million consumers although the corporation services only 700,000 consumers.[18]

Iganga Town Council has failed to provide adequate water supply to its 20,000 inhabitants. However, the Directorate of Water Development is initiating emergency rehabilitation of the town's water supply by the purchase and installation of three submersible pumps, laying of pumping mains, and extending of power supplies to

18 Ssendawula, G.M. 1997. Policy statement on the 1997/98 budget estimates presented to Parliament. Ministry of Natural Resources, Kampala, Uganda.

three pumping stations. Even though the town council has established some water selling kiosks, water supply remains erratic:

> "At times it takes a week without water in the kiosks. However, we have a few boreholes which rescue us when there is no water in the kiosks".

Due to inaccurate water meters and the high cost per unit of water (one unit is equal to 44 x 20 litre jerrycans and costs 1250 shillings), some people who had piped water previously have opted for disconnection to minimise the costs of water. According to a key informant who has stayed in the area since the 1960s, inaccurate meters are problematic to consumers.

> "It is the meters that have brought us problems. We pay for "air". The meter runs even when there is no water flowing in the house. The problem is with the type of water meter used. Some people have returned their meters to the water supply station and have resorted to boreholes to avoid all these problems".

The FGDs in Alemi consistently said that there had been minimal investment in the public sector in the area.

> "Government has completely neglected us and our local leaders cannot easily forward our problems about water to the concerned authorities."

However the FGDS were very clear about their definition of government:

> "In the past, government used to be all of us together with those in power but now it is the members of parliament and the ministers who are the government!"

The insurgency by the Lord's Resistance Army in the area has not helped development either. Limited funding from government and poorly motivated extension staff were cited as the main constraints:

> "Technicians are too lazy to repair the boreholes because government does not pay their wages and yet the local community cannot afford to pay them".

The FGDs consistently complained about LC executive and chiefs whom they saw as *"dominating the decision making process and control of resources."* They said:

> "Even where the community contributes money for repairing boreholes, the LCs always embezzle the funds. They also corrupt those who may raise complaints. This corruption is now like cancer! It is eating our society every bit of it: even water!"

6.2 Role of the Private Sector

Due to limited investment in the public sector in Iganga and Kamuli urban piped water systems, water supply has remained largely unreliable with most households having no piped connection. This marks a clear deterioration in the water situation since in DOWI most of the households in these sites had been piped.

In response to the deteriorating situation the private sector has come in to fill the gap left by lack of public investment in the water sector in the two towns. Water selling takes place in kiosks, boreholes, in addition to water vendoring. Most of the private water supply in Iganga is from privately owned boreholes which were constructed at a fee of seven-10 million Uganda shillings, and this is no small investment by Uganda standards.

This is in contrast to Tororo Senior Quarters which has had considerable public investment in the water sector and whose water supply is efficient and reliable.

6.3 Role of Civil Society Groups

A number of NGOs are involved in the construction and maintenance of boreholes in Uganda. They include LWF, Plan International, Italian Co-operation for Development, CARE and CPAR. The government assists them through the provision of drilling equipment and tax relief on imported inputs.

Through the training of Community Development and Health Assistants, the government hopes to provide water and sanitation services at sub-counties and below. The success of these cadres very much depends on their motivation, remuneration, supervision and support, components, which appeared lacking in the areas we visited.

In Alemi, CPAR had supported the construction of four shallow wells and protection of one spring. They also participated in training water management committees and water caretakers within the community to ensure sustainability. Clearly NGO resources are too stretched to adequately meet the needs of the communities. Poverty was consistently identified as the major constraint to community participation in improvement of water supply.

6.4 Cooperation Between Public Sector, Donors and Civil Society

Through the Rural Water and Sanitation (RUWASA) Project, DANIDA and the Uganda government have assisted communities in Mukono, Kamuli, Tororo, Mbale, Kapchorwa, Pallisa, Iganga, Bugiri and Jinja districts in improving water and sanitation services. During the current phase of RUWASA (1996-2001), emphasis is on the privatisation of construction of water sources and preparing and supporting districts to take over management of their water supplies.

7 Environmental Factors

7.1 Variations in Water Availability

In DOW II, 92 percent of unpiped households fetched water from a reliable water source from which water was available at all times of year. In DOW I only 38 percent (95) of the households reported having experienced a water shortage whereas 43.4 percent (164) of the households experienced a water shortage in DOW II. For both DOW I and DOW II, significantly more unpiped households reported a water shortage than the piped households (Figure 7.1).

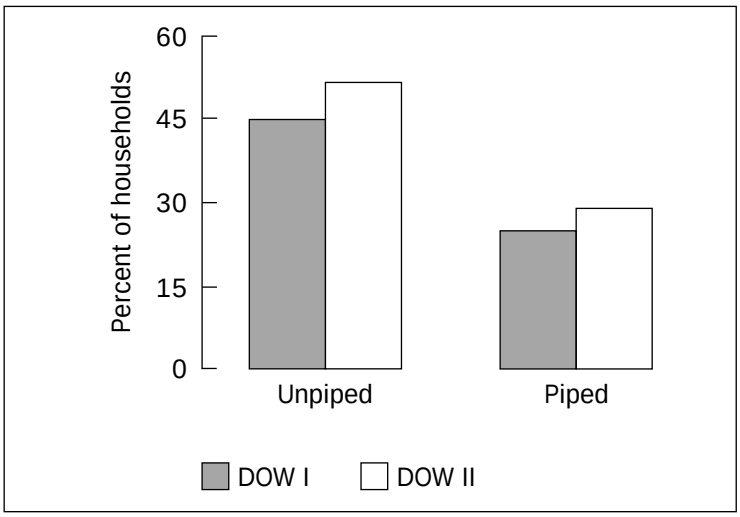


Figure 7.1 Percent of Households Experiencing Water Shortage

The photo shows a woman scooping water from a water hole in Alemi. Here, the majority of drawers get water from small holes (seeps) dug along the edge of the swamps. The drawers keep shifting the location of seeps depending on the amount of water in the area and on the rate at which water fills the seep at a particular time.

A Woman Scooping Water from an Unprotected Water Hole in Alemi

7.2 Environmental Degradation and Population Pressure

Population pressure and environmental degradation have perhaps affected Mwisi more than any other Ugandan site.

The population density in the area has increased from 170 per km^2 in 1969 to 246.1 per km^2 in 1991 (Ministry of Finance and Economic Planning, 1992). Worse still because of the population pressure, there is intensive cultivation of the very steep slopes. Because of these factors, the fields are left bare and are prone to soil erosion. Cutting of trees especially the black wattle tree cover, leads to very little infiltration and the excess runoff creates floods with erosion. When it rains heavily as a result of the *El Niño* phenomenon as was recently experienced in East Africa, huge amounts of water collect in the valleys. The rains create a lot of gullies, which continue down the water sources along the Kiruruma River.

There is also extensive land degradation due to sand extraction and brick making for sale to the growing building industry in the neighbouring Kabale town. This has damaged the landscape and led

to unsightly water pools in the excavated areas. The majority of households studied get their water from springs (protected or unprotected) or from gravity schemes which originate from springs. Some get their water from boreholes with only a few collecting water from rivers or streams. Most of the protected springs are situated along the lower hillside and the intense utilisation of the available land for housing, cultivation, sand extraction and brick making, makes the spring water somewhat biologically unsafe. Nevertheless, the protected springs have a good yield of about 1.5 litres per second. The gravity water scheme from Kitumba is often unreliable.

The women suspected the failure of the gravity water scheme was due to faulty pipes. They also claimed that either the water was not enough or it was diverted by the wealthy who live uphill. The population has outstripped the available water resources in Mwisi and this has led to frequent conflicts amongst different communities in the area. One of our key informants said:

> "We are also rudely referred to as 'intruders' by the residents of those villages in which the sources are located. To make matters worse, our husbands, the so-called men, have not responded to our outcry so that they can negotiate with the authorities in the villages where we collect the water. We have a tap in our village but we have failed to raise funds to repair it. Therefore people in the other villages do not take us seriously when we go to fetch water from their areas."

She said that in the past fighting at the water sources was rare but these days there is increased conflict and occasional serious violence.

8 Sanitation, Hygiene Behaviour and Diarrhoea

8.1 Changes in cases and possible causes of Diarrhoea

During the two studies, respondents were asked to report the number of diarrhoea cases in the household in the last seven days. The results are shown in Figure 8.1 below:

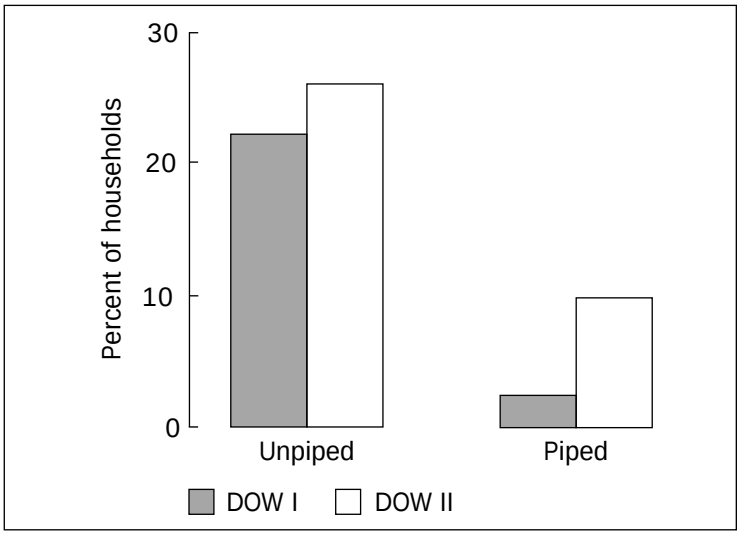


Figure 8.1 Percentage of Households with Reported Diarrhoea Cases by Type of Water Connection

Within the unpiped households, there is no significant difference (p=0.649) in the percentage distribution of households reporting at least one case of diarrhoea between DOW I and DOW II. However, within the piped households there was a significant increase (p=0.047) (Figure 8.1).

During the two study periods, the prevalence of diarrhoea has consistently remained higher in unpiped sites (24 percent in DOW I and 26.2 percent in DOW II) than in piped sites (2.4 percent in DOW I and 10.1 percent in DOW II).

Amongst the sites, the incidence of diarrhoea was worst in Alemi in both DOW I and DOW II; where 62.2 percent and 80.0 percent of households had experienced at least one case of diarrhoea in the week preceding the study (Table 11.9 in the Appendix).

Possession of a latrine would appear to be an important influence on the prevalence of diarrhoea. The proportion of households with at least one diarrhoea case is greater for those without a latrine (46.3 percent) relative to those households with a latrine (16 percent). Indeed, regression analysis confirms that latrine possession is significant at the 99 percent confidence level.

8.2 Status and Use of Latrines in 1997

8.2.1 Latrine Possession

Of unpiped households, 71.9 percent had latrines, although there was considerable variation in usage levels between sites. For example, in Alemi, Iganga (Site 25) and Kamuli (Site 35) more than 50 percent of households were without latrines.

Among the piped households, 92.4 percent had latrines. It is evident that piped households were more likely to have latrines than the unpiped households ($p<0.01$). There is no significant difference ($p=0.15$) in latrine possession between rural (74.1 percent) and urban (80.8 percent) households.

8.2.2 Latrine Type

The commonest type of latrine in the unpiped households was a pit (80.7 percent) while that among the piped was the flush toilet (68.1 percent). Surprisingly, the commonest latrine type in the urban households was the pit (49.6 percent), and not the flush toilet (33.3 percent). As expected, the pit was the commonest type of latrine in the rural households (90.3 percent) (Table 8.1).

	Unpiped			Piped Households		
	Rural	Urban	(All)	Rural	Urban	(All)
Pit	93	71	81	25	28	28
Ventilated improved pit (VIP)	5	7	6	0	3	3
Other	2	22	13	0	1	1
Flush toilet	0	0	0	75	68	68
Total	**100**	**100**	**100**	**100**	**100**	**100**

Table 8.1 Distribution of Households (percent) by Latrine Type

8.3 Latrine Hygiene

8.3.1 Contamination of Latrine Floor with Fecal Matter

In the 218 unpiped households, 31.2 percent of the latrines had fecal matter on the floor compared to 7.3 percent of the latrines in the 118 piped households. The difference was statistically significant (X^2=25.0, p=0.000).

In the rural households 32.0 percent of the 100 latrines had fecal matter on the floor compared to 19.1 percent of the 236 latrines in the urban households. The difference was statistically significant (X^2=6.7, p=0.036).

8.3.2 Contamination of Latrine Surroundings with Fecal Matter

Nine percent of the latrines in the unpiped households had fecal matter around, compared to only 0.8 percent of the latrines in piped households. However, only 1.0 percent of the 101 latrines in the rural areas had fecal matter around compared to 8.4 percent of the 238 latrines in the urban households.

It is clear that latrines in rural households are more contaminated on the floor than those in urban areas. However, latrines in urban areas have more contaminated surroundings than those in rural areas despite having clean floors.

8.3.3 Disposal of Children's Feces

Of the unpiped households, 9.4 percent disposed children's feces by throwing in the garden while 98.9 percent of the piped household disposed the feces by putting them in the toilet/bucket. Amongst the rural households, 15.7 percent disposed the feces by throwing in the garden compared to only 1.1 percent of the urban households.

Site	1967	1997
Alemi (Ayer	23	32
	62.2%	80.0%
Iganga - Rural	3	9
	10.7%	30.0%
Iganga - Urban	2	6
	11.1%	18.2%
Kamuli - unpiped	37.5%	13.3%
Mwisi	3	5
	11.5%	14.3%
Kasangati	2	5
	7.4%	14.7%
Mulago	1	3
	6.75	10.0%
Iganga - piped	–	1
	–	2.9%
Kamuli - piped	1	10
	4.3%	25.0%
Tororo - Low	–	2
	–	5.1%
Tororo - Medium	1	3
	6.7%	9.1%

Table 8.2 Prevalence of Diarrhoea During the Past Week within Households by Site, 1967 and 1997.

9 Conclusions, Key Issues and Recommendations

9.1 Conclusions

- Mean per capita water use in the unpiped households has marginally improved from 11.5 litres in 1967 to 16.5 litres in 1997, while that in the piped households has declined from 108.3 to 58.5 litres.

- Despite the decline for piped households and the increase for unpiped households, per capita water use for the former group is still 2.4 times more than that in the unpiped households

- The most intensive water activities in the piped households are toilet flushing, bathing and washing.

- In the unpiped households bathing and washing are the most water intense activities.

- The amount of water used for drinking and cooking is approximately the same regardless of type of connection. Increases in the amount of available water will be likely to have positive effects in improved sanitation.

- Socioeconomic factors having a positive effect on per capita water use in the unpiped households include: urban location, proportion of females in the household, household head is a business person, equipment index, and using water for livestock.

- Factors having a significant negative effect on per capita water use include number of people in the household, proportion of children, and use of rain during the year.

- The main drawers of water are women and children, with porter and vendors playing a marginal role. Vendors are, however, an important water source in urban sites classified as piped during DOW I (i.e Iganga).

- The range of choice (average number of water sources) has increased from 1.7 to 3.2. However only 42 percent of the water sources used by unpiped households can be considered safe.

- The majority of the households draw their water supply from springs; hand pumped wells or standpipes.

- The *debe* observed in almost 60 percent of households in 1967 is now extinct and has been replaced by the ubiquitous *jerrycan* (91.2 percent).

- The vast majority (83 percent) of the drawers of water walk to the water source with only a handful using bicycles (11 percent) or hand drawn carts (four percent).

9.2 Key Issues and Recommendations

9.2.1 Changes in domestic water use

There has been a significant decline (50 percent) in per capita water use for households with piped connections. There is a need to reverse the trend by increased investment in water sector in the rural and urban areas.

> While the mean daily per capita water use has almost doubled in the unpiped households, the level is still below the recommended 20 litres per capita per day. Any increase in available water is likely to have important positive effects on sanitation.

9.2.2 Determinants of water use

In both unpiped and piped households the main determinants of per capita water use are the household's 'wealth' and cost of water.

Piped households still pay much less than households obtaining water from vendors.

> Clearly there is need to initiate policies and projects to improve the economic well being of the households and to review the overall pricing of water in order to address the needs of the poor.

9.2.3 Deterioration of pipe water systems

Most of the piped systems have experienced a significant deterioration mainly because of the stress of increasing urban population, and lack of system maintenance and investment. Households paying flat rates experience serious problems with their water supply, resulting in situations described as "paying for air".

> In order to halt deterioration, there is need for innovative approaches to investment financing and capacity building of private and public and local consumer's groups.

9.2.4 Burden of water collection

The burden of water collection is still borne by women and children. This is aggravated by long waiting times at the source and labour intensive methods of carrying water.

> There is a clear need to alleviate this burden by improving economic and general well being of women and children enabling them to participate in household and community decision making process.

9.2.5 Health

Clearly diarrhoea and other water related diseases are still a problem. Unsafe water sources, poor sanitation and unhygienic practices increase the rate of diarrhoea.

> There is a clear and pressing need to increase levels of investment in water and sanitation facilities. These must be accompanied by hygiene programmes to maximise health benefits.

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11 Appendix

	Mean	Std Deviation
Per Capita Observed Use	17.87	9.71
Site is Urban - Dummy	.48	.50
Number of People in Household (Log)	6.42	3.40
Proportion of Children in Household	.46	.23
Proportion of Females in Household	.57	.20
Equipment Index - Standard of Living	6.10	3.09
Highest Educational Level in Household	8.60	4.22
Household Head is a Farmer - Dummy	.40	.49
Household Head is a Business Person/Artisan - Dummy	.21	.41
Household uses Water for Gardening - Dummy	.06	.24
Household uses Water for Livestock - Dummy	.14	.35
Household uses Rainwater during the Year - Dummy	.75	.43
Distance to Source - Return Journey (weighted average, all sources in metres)	287.37	293.69

Table 11.1 Model 01 Unpiped. Descriptive Statistics

Note Valid sample is 235

	Minimum	Maximum	Mean	Std Deviation
Predicted Value	1.336	36.048	17.874	6.800
Std. Predicted Value	–2.432	1.336	36.048	17.874
Standard Error of Predicted Value	.955	–2.432	2.673	.000
Adjusted Predicted Value	.725	.955	3.337	1.628
Residual	–19.124	.725	34.467	17.857
Std. Residual	–2.687	–19.124	34.163	.000
Stud. Residual	–2.762	–2.687	4.799	.000
Deleted Residual	–20.211	–2.762	4.882	.001
Stud. Deleted Residual	–2.804	–20.211	35.350	.017
Mahal. Distance	3.220	–2.804	5.155	.004
Cook's Distance	.000	3.220	50.412	11.949
Centered Leverage Value	.014	.000	.096	.005

Table 11.2 Model 01 Unpiped. Residual Statistics

Table 11.3 Model 02 Unpiped (Logarithmic). Descriptive Statistics

Note Valid sample size N=209

	Mean	Std Deviation
Per Capita Water Use (Log)	2.727	.494
Site is Urban - Dummy	.450	.499
Proportion of Children in Household	.479	.221
Proportion of Females in Household	.570	.199
Household Head is a Farmer - Dummy	.426	.496
Household Head is a Business Person/Artisan - Dummy	.177	.383
Household uses Water for Gardening - Dummy	.067	.251
Household uses Water for Livestock - Dummy	.144	.351
Household uses Rainwater during the Year - Dummy	.756	.431
Number of People in the Household (Log)	1.772	.505
Weighted Distance to Source - in metres (Log)	5.263	1.090
Highest Education in Household (Log)	2.056	.518
Equipment Index (Log)	1.687	.492

Table 11.4 Model 02 Unpiped (Logarithms). Residual Statistics

	Minimum	Maximum	Mean	Std Deviation
Predicted Value	1.765	3.906	2.727	.359
Std. Predicted Value	–2.678	3.283	.000	1.000
Standard Error of Predicted Value	.051	.152	.085	.019
Adjusted Predicted Value	1.687	3.874	2.726	.360
Residual	–1.101	.910	.000	.339
Std. Residual	–3.151	2.604	.000	.971
Stud. Residual	–3.238	2.666	.000	1.003
Deleted Residual	–1.162	.953	.000	.362
Stud. Deleted Residual	–3.319	2.708	.000	1.009
Mahal. Distance	3.465	38.235	11.943	6.080
Cook’s Distance	.000	.057	.005	.008
Centered Leverage Value	.017	.184	.057	.029

Table 11.5 Model 03 Piped. Descriptive Statistics

	Mean	Std Deviation
Per Capita Water Use - Observed	57.410	53.555
Site Located in an Urban Area - Dummy	.981	.136
Number of People in the Household	7.000	4.005
Proportion of Children in Household	.391	.234
Proportion of Females in Household	.560	.207
Household has Electricity - Dummy	.897	.305
Wealth Index of Piped Households	9.925	1.862
Highest Educational Level in Household	14.411	2.681
Cost per Litre for Piped Source (Shillings and Cents)	.838	.807
Household Head is a Farmer - Dummy	.000	.000
Household uses Water for Gardening - Dummy	.308	.464
Household uses Water for Livestock - Dummy	.206	.406
Number of Taps in Household	2.121	1.847
Daily Number of Water Service Hours	3.336	1.132

Table 11.6 Model 03 Piped. Residual Statistics

	Minimum	Maximum	Mean	Std Deviation
Predicted Value	–21.899	159.487	57.410	42.614
Std. Predicted Value	–1.861	2.395	.000	1.000
Standard Error of Predicted Value	6.847	25.414	11.507	3.442
Adjusted Predicted Value	–38.453	198.164	57.462	45.249
Residual	–79.798	114.346	.000	32.437
Std. Residual	–2.317	3.320	.000	.942
Stud. Residual	–2.586	3.547	.000	1.036
Deleted Residual	–131.964	131.964	–.016	40.243
Stud. Deleted Residual	–2.669	3.791	.004	1.058
Mahal. Distance	3.198	56.711	11.888	9.151
Cook's Distance	.000	.615	.022	.085
Centered Leverage Value	.030	.535	.112	.086

Table 11.7 Model 04: Piped households (Logarithms) Descriptive Statistics

Note Valid sample size N=97

	Mean	Std Deviation
Per Capita Water Use (Log)	3.696	.868
Site Located in an Urban Area - Dummy	1.000	.000
Number of People in the Household	1.812	.543
Proportion of Children in Household	.386	.237
Proportion of Females in Household	.545	.204
Household has Electricity - Dummy	.887	.319
Wealth Index (Log)	2.284	.195
Highest Educational in Household (Log)	2.652	.241
Cost per Litre in US Cents (Log)	–.300	.467
Household Head is a Farmer - Dummy	.000	.000
Household uses Water for Gardening - Dummy	.320	.469
Household uses Water for Livestock - Dummy	.206	.407
Number of Taps in Household	.523	.646
Hours of Water Service (Log)	1.126	.482

Table 11.8 Model 04 Piped (Logarithms) Residual Statistics

	Minimum	Maximum	Mean	Std Deviation
Predicted Value	2.642	5.190	3.696	.712
Std. Predicted Value	–1.505	2.097	.000	1.000
Standard Error of Predicted Value	.113	.366	.180	.045
Adjusted Predicted Value	2.591	5.174	3.696	.717
Residual	–1.240	1.280	.000	.496
Std. Residual	–2.354	2.430	.000	.941
Stud. Residual	–2.435	2.695	.000	.999
Deleted Residual	–1.327	1.575	.000	.560
Stud. Deleted Residual	–2.509	2.802	.001	1.012
Mahal. Distance	3.426	45.252	10.887	6.786
Cook's Distance	.000	.140	.011	.020
Centered Leverage Value	.036	.471	.113	.071

Table 11.9 Prevalence of Diarrhoea During the Past Week within Households by Site, 1966 and 1997

Site	1966	1997
Alemi (Ayer)	23	32
	62.2%	80.0%
Iganga - Rural	3	9
	10.7%	30.0%
Iganga - Urban	2	6
	11.1%	18.2%
Kamuli - unpiped	6	4
	37.5%	13.3%
Mwisi	3	5
	11.5%	14.3%
Kasangati	2	5
	7.4%	14.7%
Mulago	1	3
	6.7%	10.0%
Iganga - piped		1
		2.9%
Kamuli - piped	1	10
	4.3%	25.0%
Tororo - Low		2
		5.1%
Tororo - Medium	1	3
	6.7%	9.1%

Appendix 1. Uganda Piped Households, DOW I & II

	Number of Households		Average Number of Years of Education		Average Per Capita WU (litres)		Average Total Water in Household (litres)		Average Cost (1997 US$ pcm)		Receive 24-hour supply (percent of households)		Principal Alternative Source if Piped System breaks		Reported diarrhoea incidence during the previous week (% households)	
	DOW I	**DOW II**	**DOW I**	**DOW II**	**DOW I**	**DOW II**	**DOW I**	**DOW II**	**DOW I**	**DOW II**	**DOW I**	**DOW II**	**DOW I**	**DOW II**	**DOW I**	**DOW II**
Same Sites as DOW I																
Iganga	19	5	7.42	10.40	78.72	34.23	389.04	273.05	0.89	0.58	100.00	0.00	Rain	Kiosk	0.00	0.00
Kamuli	23	19	9.78	12.68	76.23	32.43	399.26	176.83	1.06	1.82	100.00	0.00	Rain	Well	4.35	21.05
Tororo-Low	27	39	12.81	15.74	160.91	110.72	843.03	692.11	0.59	0.57	100.00	97.44	Rain	Other	0.00	5.13
Tororo-Medium high	15	28	8.27	14.36	100.05	27.80	465.21	160.11	0.69	0.57	100.00	100.00	Rain	Reservoir	6.67	10.71
'Newly' Piped																
Iganga-Urban		2		11.50		16.34		153.85		0.67		0.00		Well		0.00
Kamuli		4		13.50		25.28		196.20		1.95		25.00		Spring, well		50.00
Kasangati		4		15.25		73.93		288.88		---		0.00		Well		0.00
Mulago		8.0		13.56		36.19		281.11		0.58		77.78		Spring		5.56
Total	**84**	**109**	**9.95**	**14.21**	**108.27**	**58.53**	**551.36**	**365.61**	**0.80**	**0.80**	**100.00**	**68.07**			**2.38**	**10.08**

Appendix 2. Uganda Unpiped Households, DOW I & II

	Number of Households		Average Number of Members in Household		Average Number of Years of Education		Average Equipment Index		Average Per Capita WU (litres)		Average Cost (1997 US$ pcm)		Principal Water Source		Average Time Per Trip (Minutes)		Average Distance to Water Source (Metres)		Average Number of Trips		Diarrhoea Incidence in Previous Week	
	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I	DOW II	DOW I
Same Sites as DOW I																						
Urban Households	69	49	5.67	5.84	9.94	5.12	6.25	5.65	23.48	14.34	1.45	0.68	Hydrant, well	Hydrant, rain	13.38	6.13	155.57	177.23	3.69	2.23	0.14	0.18
Rural Households	135	118	6.70	5.03	7.42	3.28	5.77	3.66	14.78	11.52	0.71	0.52	Spring	Spring, well	18.89	12.88	381.22	343.57	3.21	2.35	0.38	0.26
Iganga - Urban	31	18	5.48	5.83	9.29	4.94	5.52	5.72	22.21	13.85	1.91	0.68	Hydrant	Hydrant	14.67	3.72	117.42	114.89	3.07	1.50	0.19	0.11
Kamuli	26	16	5.12	5.31	8.88	4.38	5.12	5.94	25.79	16.05	0.77	0.20	Well	Hydrant	16.42	5.90	293.73	221.89	4.21	1.30	0.08	0.38
Mulago	12	15	7.33	6.40	13.92	6.13	10.58	5.27	21.57	13.10	1.77	1.21	Hydrant	Spring	13.70	9.92	104.50	233.50	6.60	4.08	0.17	0.07
Alemi (Ayer)	40	37	7.00	5.22	5.93	3.25	4.83	3.00	15.71	17.57	0.62	1.18	Spring	Well	25.32	13.30	459.45	423.20	4.00	2.69	0.80	0.62
Iganga - Rural	30	28	7.03	4.75	6.33	3.93	5.10	4.21	15.46	12.70	0.45	0.09	Spring, Well	Spring	22.78	6.71	442.32	191.15	3.44	1.75	0.30	0.11
Mwisi	35	26	5.91	4.77	7.37	1.96	4.74	2.42	9.10	4.46	0.64	0.09	Spring	Spring	15.33	20.88	368.40	328.72	2.00	2.04	0.14	0.12
Kasangati	30	27	6.87	5.33	10.57	4.04	8.90	5.19	19.54	8.83	1.20	0.48	Spring, Well	Spring	9.92	10.75	200.68	414.73	3.43	2.91	0.17	0.07
Newly Unpiped																						
(all urban)	56		6.39		10.76		7.63		20.24				Vendor, well		10.81		120.96		3.15		0.13	
Iganga	30		6.57		11.21		8.77		20.74		3.15		Vendor, Kiosk		8.42		84.79		3.12		0.03	
Kamuli	21		6.29		9.81		6.29		19.75		1.80		Well		14.78		200.16		3.28		0.29	
Tororo - MH	5		5.80		12.20		6.40		19.29		1.54		Neighbour		7.40		29.80		2.67		0.00	

Note: Equipment Index – A measure of relative wealth based upon an index of observable physical equipment and tools was used as a partial surrogate of income in unpiped households