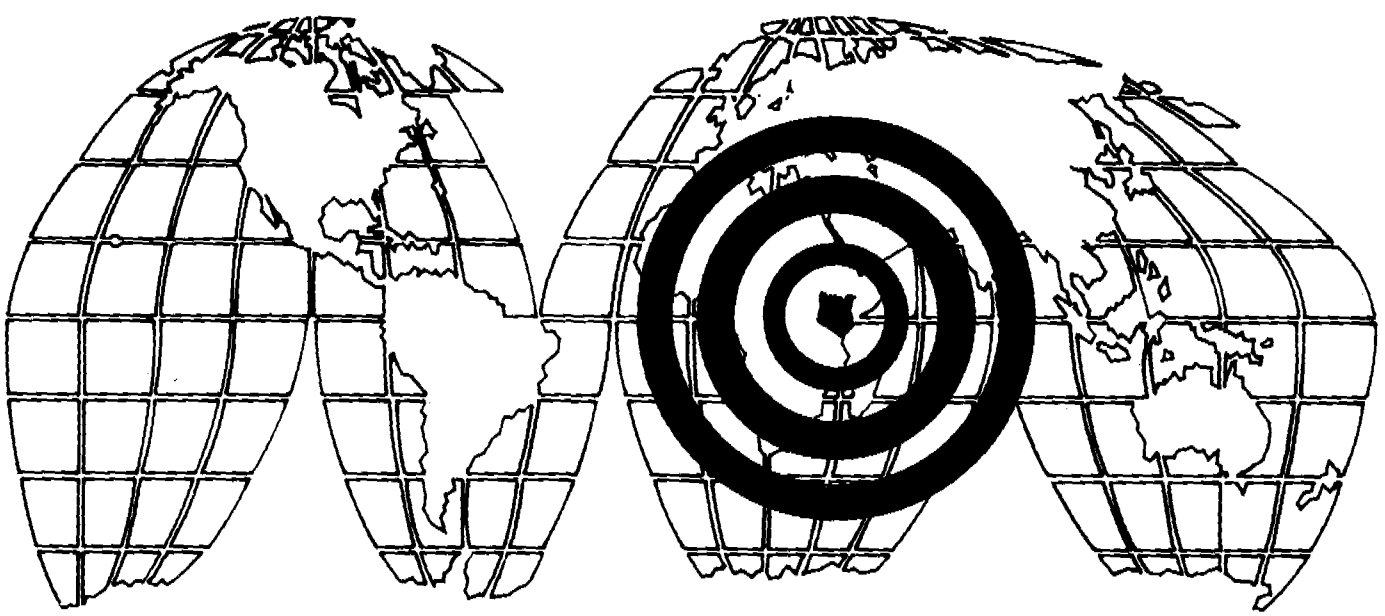
A.I.D. Project Impact Evaluation Report No. 5

Kenya Rural Water Supply: Programs, Progress, Prospects



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SPECIAL STUDIES

No. 1: Afghanistan Basic Village Health (Forthcoming)

PROGRAM DESIGN AND EVALUATION METHODS

Manager's Guide to Data Collection (November 1979)

CONTENTS

EXECUTIVE SUMMARY

Since 1970, the Government of Kenya has been involved in a program to bring water to all its population. During this period the investment has been very high, but the results have been disappointing. The government is still committed to the long-term goal of universal supply, but there is a recognition that competing demands may now require a review of the long-term objectives for water development. The lessons from the past efforts in water supply are not only important for Kenya but for AID, as it assists water supply projects, and for any country undertaking a large national program in water supply.

The national rural water program in Kenya differs from that in most other countries in two ways: size of the project and method of supplying water. The typical Kenyan water system is large and over the past decade has been getting larger. The aim of most systems is to supply water to individual families through metered private connections. Since most families live in dispersed communities this means long distribution lines.

These large, complex systems are not working well. There are problems of design, construction, and maintenance that make the systems unreliable. The problems of maintenance are primarily the result of the low funding levels provided by the government. In addition to the problems of reliability, which limits the number of people served, the government discourages the use of communal facilities by locating them inconveniently and sometimes closing them completely. This means that often rural systems deliver water to a small number of elite users.

AID has provided funding to self-help systems through CARE-Kenya. Systems built by communities under self-help programs also have problems of reliability but usually serve the entire community.

There are a number of lessons and policy implications for both AID and other developing countries adopting a national program. These include insuring adequate funding for operation of systems, selecting technology from the full range of options available, and involving the community in the process of providing supplies.

PREFACE

The evaluation of Kenya rural water supply was carried out during a 5-week period beginning July 23, 1979.* It covered 22 communities in the Eastern, Central, Rift Valley, Western and Nyanza Provinces. Four types of systems were surveyed. They were those:

1. built and operated by the Ministry of Water Development (MWD);
2. built by others but operated by the MWD;
3. Harambee or self-help projects; and
4. water projects built, owned, and operated by associations of members.

The team interviewed officials from the Ministry of Water Development; bilateral and multi-lateral donors; consulting firms active in the rural water supply field and AID personnel. In the field the team was accompanied by an engineer from the Ministry of Water Development. The only limitations in examining the actual operating conditions of the water systems were imposed by time, distance and road conditions.

Regional and District water engineers were interviewed and physical inspections were made of individual systems. In each village a standardized interview was completed. Where possible, the village chairmen and/or secretary and some village elders were present. For those systems that were built by Harambee committees as many members of the committee as were available were assembled. Women were seldom part of the interviewed group but would gather at the site of the meeting. There were exceptions. One woman was a member of a Harambee committee and women participated in some of the group interviews. At one site it was the women who answered questions about the benefits of the supply.

The team is grateful for the support of the Ministry of Water Development which detailed an official, Moses Sika, to assist with the field work, and to the other donors--the Swedish (SIDA) and the Canadian (CIDA) development agencies; CARE-Kenya, and the World Bank which provided evaluation studies and information about their activities. We are especially grateful to Martha Whiting of CARE-Kenya and to Abagail Krystal, a CARE consultant, who provided us with a manuscript of a recently completed study of CARE-Kenya projects.

Finally, we would like to acknowledge the excellent cooperation received from the Kenya Mission which made the task not only possible, but pleasant.

*The team consisted of Daniel Dworkin, Bureau for Program and Policy Coordination, Office of Evaluation, U.S. Agency for International Development; and Ross Hagan, Development Alternatives, Inc.

I. POLICY, INSTITUTIONS, SETTING

A. Introduction

Since 1970, the government has been actively pursuing a major program to provide everyone in the country with an improved source of water by the end of the century. The government assumed that if supplied with water the people would enjoy a high cash income, more reliable subsistence, improved health, and more leisure.

The program has been successful in the urban areas, where virtually everyone now has access to water from a municipal system. In the rural areas only a small number of people are served. Estimates are that 1.5 million people live in communities with water systems, but not all these people have a reliable source of supply.

The program to build water supplies in rural areas has not failed because of lack of investment. The Ministry of Water Development (MWD) is allocated more development funds than any other agency of the government. More than $70 million has been invested since 1970. The 1979 budget calls for a further investment of $24 million for new water supply systems and $4 million for rehabilitation of existing ones. In the five year period 1979-1983, $165 million in new construction and $18 million for rehabilitation of existing systems is budgeted.

The investment has been assisted by a number of donors. The major support has come from the Swedish Government through SIDA which provided $40 million. Others which have provided funding are the World Bank, Canada, the Netherlands, UNICEF and a number of private voluntary organizations. The United States has funded the supply of materials through a grant to CARE-Kenya.[1]

The problem, however, seems intractable. As new systems are built, recently completed ones are going out of service. The government has recognized the problem and in the new five year development plan for 1979-1883, had adopted an interim goal which is more modest, increasing the number of rural residents served to 4 million. This is an increase of 2.5 million over those currently considered as having water supplies.

Even if the program to provide 2.5 million more people in the rural areas with water is successful, it may leave almost as many people without water at the end of the five year period as there were in 1979 because of population growth. Kenya has one of the

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[1] The present Operational Program Grant to CARE-Kenya for $300,000 ends in 1979. Additional assistance is being considered. A preliminary proposal for assistance to self-help programs has been reviewed in 1979.

highest rates of population increase in the world. The official estimate of the growth rate is 3.5 percent, but some demographers estimate present growth to exceed 4 percent and project that it will continue at this rate through the five year planning period. Using these assumptions, the present population of 15.8 million will rise to 19.5 million by 1984.[2]

B. Project Selection

With a growing realization that the goal of universal service may be unreachable in the near future the question of who will recieve the systems becomes more important. All water systems built with central government assistance must be approved by the local District Development Committee (DDC). The DDC includes district officials, representatives of the central government, members of Parliment, local government officials and elected members of local government. Theoretically, selection of the communities and determination of priorities is on the basis of need, but communities represented by articulate and influential spokespersons are the ones most likely to receive high priority. Since these are often the wealthier more educated communities, poorer communities are often overlooked. A change is planned. During the middle of the present planning period the government will shift in emphasis to the basic needs policy. This will be accomplished by changing the method of project selection to ensure that projects are provided for the communities with the greatest needs.[3]

C. Ministry of Water Development (MWD)

The government has given the MWD the overall responsibility for "the development, operation and maintenance of supplies and conservation of the nation's water resources". The MWD was formed as a separate agency in 1974. Previously it had been a branch of the Ministry of Agriculture.

The Ministry functions as a highly centralized unit with planning and project implementation centered in the headquarters at Nairobi. It has branch offices in each of the eight provinces. The regional offices are headed by a Provincial Water Engineer (PWE). The responsibilities of the PWE are to operate and maintain the systems

[2] Recent Demographic Trends in Kenya and Their Implication for Economic and Social Development. R.A. Henin, F. Mott and S. Mott. Mimeo n.d.n.p., p. 26.

[3] Development Plan for the Period 1979 to 1983, Part I, Government of Kenya, p. 194.

in the Province, to extend existing distribution lines, to install individual connections, and to provide technical assistance to small self-help projects. Each provincial office has a number of district offices headed by a District Water Officer (DWO). The operations of the provincial offices are hampered by poor communications, lack of vehicles, poorly trained staff, shortages of funds, and a restrictive procedure that prevents purchase of local supplies and equipment.

D. Institutional Support

Rural water supply construction activities of the MWD are undertaken under two different categories. The main program is the Rural Water Supply Program (RWS). Originally started in 1970, there are now four separate programs: RWS I, RWS II, RWS III, and RWS IV. The first three were jointly funded by the Governments of Kenya and Sweden; the RWS IV program is funded through an agreement with the World Bank. The program is currently in its fourth phase. RWS I was funded in 1970 and had a scheduled completion date of 1972. The other two programs followed successively and were to last two years.

E. Self-help Programs

A second program that is now the responsibility of the MWD is the Harambee or self-help water projects. Self-help is a concept actively promoted as a development strategy by the first President of Kenya, Jomo Kenyatta, and is being continued under President Moi. Self-help is not confined to water; it has been responsible for many of the schools and health clinics in rural areas. Self-help programs raise funds and mobilize community contribution of labor for specific projects. Approval by the DDC is required before a project can be designated an official Harambee project. When approval is obtained, the MWD regional office assists the effort by furnishing technical advice on design, construction and operation, and by contributing materials.

Aside from assistance to CARE, additional U.S. assistance is provided by Peace Corps volunteers attached to regional offices of the MWD. They, too, furnish technical advice on design, construction, and operation of self-help systems.

F. New Directions

Projects by the MWD never have involved the public in the development of new water schemes. In contrast, self-help schemes represent the ultimate in public involvement. Beginning with the systems designed in 1982, a new approach will be introduced that will integrate

the self-help projects and the regular MWD program. The result envisioned will be to spread the public funds for water over a larger population.[4]

G. Physical Setting

Rural water supply projects are resource management activities, changing the distribution of water over time and space. If water sources are close and if they are available through the year in sufficient quantity even during years of drought, the problem is easy. This is not true in Kenya. Rainfall variability is extreme between areas of the country, between seasons, and from year to year. Although some of the higher areas between Nariobi and Lake Victoria receive 2500 millimeters of rainfall, over seventy percent of the land area is classified as arid or semi-arid. Along the northern border some areas receive less than 25 millimeters of rain annually.

Rain is not distributed throughout the year, but falls in one or two rainy seasons. During the rest of the year many streams and ponds are dry. Stream flows during many periods are high, washing out water intakes located along rivers and silting up intakes, pipelines, and reservoirs. Reservoirs must be large to provide storage during drought periods. Under these conditions groundwater is usually a better source. Groundwater, however, is limited and when it does occur the quality is often unsatisfactory.

H. Patterns of Settlement

Population densities in the rural areas of Kenya vary between 2 to over 2000 persons per square mile depending primarily on the agricultural potential of the land. In the sparcely settled areas the population is often nomadic, but even in the most densely settled areas people live in dispersed communities on the land they cultivate, rather than in towns. The dispersed population complicates the problems of providing water service especially in light of the government's emphasis on individual private connections as the standard of service. In the areas of the country that are classified as having high or medium agricultural potential and where 80 percent of the rural population live, the government policy is that the use of private metered connections is either preferred (high potential) or encouraged (medium potential areas). The emphasis on private connections where the population is dispersed requires long distribution lines and results in high per capita costs (Table 1). Also the preoccupation with large complex systems has by-passed the more remote communities

[4] Development Plan, op.cit., p. 3.

especially the people living in the arid and semi-arid lands with low agricultural potential. The newly announced policy on project selection is designed to shift the present emphasis to communities currently not considered.

II. PRACTICES

A. Rural Water Supply Program

The MWD is responsible for all water activities in Kenya. The RWS program is the major effort of the MWD. In the Development Plan it receives two-thirds of the budget for rural water supply systems. The programs to build rural water systems in Kenya have been uniformly subject to delay, cost overruns, and overstatement of the population served by the system. The RWS I program finished approximately half the systems scheduled by the completion date. The cost of the systems built was 95 percent higher than planned. The RWS II program was subject to more delay; less than half the systems were built during the two year project period. Cost overruns, however, had declined to 59 percent. In the RWS III program delay increased. The present estimates are that the program will be completed in 1980, four years behind schedule for a two year program.

The reasons for the delay include problems of obtaining materials from suppliers both within the country and from abroad, a six to eight month bureaucratic delay in purchasing of materials, restrictions on imports, lack of skilled staff, shortage of transport and drivers, poor coordination with regions and bad administration. Cost overruns were caused by the increased costs of labor and materials; inadequate and inaccurate baseline data; expansion of the size of systems; and, above all, implementation delays in a time of rapid inflation.[5] A brief summarization of four typical RWS schemes is shown in Table 1.

B. Self-help

Self-help projects are credited with supplying 18 percent of all those served by rural water systems. The government is shifting the emphasis from the regular RWS program to the self-help mode to increase the impact of rural water investments. A donor has funded over $7 million worth of materials and consultant services over the plan period.

The CARE-Kenya Water Development Program started in 1975 with AID financial assistance. The objective was to provide materials and equipment to support Harambee projects which had raised at least half of the funding from the community. The projects were to be

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[5] Rural Water Evaluation, op.cit., Vol. II, 8/5. Also see Appendix B.

TABLE 1

COSTS OF FOUR SYSTEMS AND THEIR PIPE AND FITTINGS FOR DISTRIBUTION NETWORKS

PROJECT	COST OF PIPE AND FITTINGS ($U.S.)	TOTAL COST OF SYSTEM	% OF PIPES TO TOTAL COST	NUMBER OF INDIVIDUAL CONNECTIONS	NUMBER OF COMMUNAL WATER POINTS[a] (x100)	NO. OF FAMILIES SERVED	COST PER[b] FAMILY SERVED ($US) PIPE & FITTINGS	TYPE OF SYSTEM
Tetu Thegenge	1,000,657	1,319,100	76	889	10	1389	720	gravity
Inoi	212,800	309,429	69	886	5	1136	187	gravity
West Karachuonyo	340,062	531,160	64	19	50	2519	135	diesel pumped
Chepalungo	473,858	655,019	72	40	58	2940	161	diesel pumped

[a] Including Kiosks.

[b] Assuming 50 families for each communal water point and one family per individual connection.

Source: Rural Potable Water Supply Evaluation, Vol. III, Annex, VIAK, Nairobi, 1978.

designed, supervised and inspected by the MWD. Villagers were to contribute funds and labor. CARE was to select projects, provide materials and administer the project.

The CARE-Kenya program was designed to complete thirty projects annually that would serve 300,000 people. After the first year's efforts only ten projects had been completed. Per capita costs are more than twice the project estimate. AID's contribution was to be $1.00 per beneficiary. The actual costs were $2.07 for the first systems finished.[6] Even this increase of over 100 percent understates the actual cost per beneficiary since some of the systems were not working at all and others were not working reliably during the team visit.

Reasons given for the problems are widely scattered projects, which are difficult to supervise; little or no contribution by the community; and little assistance from the government which had agreed to design, supervise, and inspect the selected systems.

Three CARE projects were visited in the evaluation (Appendix D). Only one was providing a reliable source of supply. Two of the systems were poorly designed. The system serving Riuri that CARE listed as completed in 1975 is still not operating. The Riuri project is not completely typical of systems that CARE has assisted, but it is illustrative of the diffusion of effort over a long period of time that goes into some of the self-help projects in Kenya. In addition to the support given by CARE, Riuri has received funding from the Italians, the Dutch, a Dutch private organization, and a loan from a cooperative bank. When another CARE project, the Raphedi system, is completed it will share an intake and pump which is currently inadequate to serve a neighboring market town.

C. Future Directions

The government is concerned with the implications of the costs and effectiveness of the entire rural water program and is planning a review of the long-term objectives during the early period of the new planning period. A number of reasons are cited. Water development must compete with other needs, costs of the projects are increasing faster than available funding, schemes are getting larger and more complex, technical manpower is short, and there is a need to direct more funds to maintaining existing schemes.[7]

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[6] "An Evaluation of CARE Assisted Village Water Development Activities in Kenya", Huntley Biggs and John R. Schott, American Technical Assistance Corporation, August 28, 1976.

[7] Development Plan, op.cit., p. 193.

III. IMPACT

In traveling through rural Kenya it soon becomes clear that people value water projects highly. It is, in a sense, surprising since the failures of systems are well known throughout the area and, furthermore, studies on the impact of rural water supplies on the users have not shown substantial benefits to the community from improved supply. Certainly, if there is an impact, it must be found among the users of systems that work.

A. Reliability

Rural systems in Kenya range from those which are completely reliable to those which never work. Along this continuum the MWD has defined reliable systems as those which do not have repetitive interruptions in service which continues for two days. Using this definition on a large sample of MWD water systems, VIAK found that 55 percent were reliable.[8] These systems were built under the RWS programs. In the mix of systems visited in the current evaluation, 43 percent (10 of 23) were reliable.

The reasons for systems not working are often simple -- no fuel, a broken pipeline or an intake plugged with silt. Sometimes they are more complex and exceed the ability of those responsible for their maintenance.

Most regional and district offices are not equipped to operate and maintain the systems which are their responsibility. In the visits to regional and district offices the following problems are apparent.

-- The areas that regions cover are far larger than can be adequately covered. Some systems are more than a day's travel from the nearest office.

-- Transport of all kinds is short and repair facilities for existing vehicles are inadequate.

-- Some systems that require periodic supplies of fuel are remote and often located on roads that are difficult at any time and impassible in rainy weather.

Some of the technologies to deliver water are inherently more reliable. Gravity systems require no fuel deliveries and are not out of service for long periods because of shortage of engine components.

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[8] Rural Water Evaluation, op.cit., Vol. I, p. II, 1, 17.

In the systems visited in the evaluation more than half of those depending on gravity were reliable while only a quarter of the diesel systems were operating satisfactorily (Table 2). Main problems were design, poor maintenance, and lack of fuel.

TABLE 2

RELIABILITY OF OBSERVED SYSTEMS BY TECHNOLOGY

Technology	Number	Number Reliable	Percent Reliable
Diesel Driven Pumps	12	3	25
Gravity	9	5	55
Other (Electric Pumps)	2	2	100
TOTAL	23	10	43

B. Users

The method of supplying water to users preferred by the MWD in all but low potential areas, is the individual metered private connection. In an effort to encourage users to pay for individual connections, the MWD restricts the number of communal water points (CWPs), closes some after construction, fails to repair those that go out of service, and restricts the hours of water availability at ones that are open. The effect is to decrease the numbers of people served by a system. When the users of a system are primarily served by CWPs and these are closed, the population served by the system may decrease dramatically. The result is that often the users of rural water systems operated by the MWD in Kenya are the wealthier members of the community. The reasons grow out of the policy of the government to collect payments for water used.[9] The objective of requiring users to pay is desireable, but the effect of the operation of the payment system sometimes means that rural water supplies are highly subsidized methods of bringing water to an elite minority.

A study of four systems over a period of time documents the restriction of service at CWPs.[10] The four systems had 329 CWPs when they were constructed in 1973. By 1976, nearly two-thirds had been closed.

[9] For a revised statement of the newly announced policy on water pricing, see Appendix 6.

[10] Rural Water Evaluation, op.cit., p. 6/5.

One system, Tetu Thegenge, originally had 125 CWPs which were installed to serve 67,500 people. All were subsequently closed and the system, which cost over $1,300,000, was serving 889 unmetered private connections. Each connection represented an investment by the government of nearly $1,500. Calculating the depreciation on weighted average of 28 years and without interest on the investment, the system requires an operating subsidy of $100 per year for each private connection.[11] This is in addition to the $25/per connection paid in water rates annually. (See Table 3.)

The same conditions were observed in the field evaluation. In six of the ten reliable systems visited, users without individual connections were discriminated against in the provision of water. In a seventh, the system -- although it was capable of functioning adequately -- was operating for only two hours a day to encourage users to pay for individual connections. The following conditions were observed in the evaluation.

> The Lake Nakuru Settlement Scheme employs six people to operate a new electric submersible pump installed in a deep well. Two lister motor generator sets (one in operation and one a spare) provide electricity to the pump. Water is supplied to the village for one hour in the morning and one hour in the afternoon. Most of the community cannot be served in this period and must resort to traditional sources of supply at some distance from the village.
>
> Nyabondo is a system providing treated chlorinated water to 172 individual connections and six CWPs. Twenty-two CWPs in a high density population area were closed because taps were inoperative. Fifteen employees run the system which includes four diesel pumps and a well-designed treatment plant.
>
> The West Acre Pipeline employs four people and serves only 96 private connections. All CWPs are closed.
>
> The Alour Project was started as a Harambee scheme in 1964. Since then the operation and maintenace of the system have been taken over by the MWD. The system serves ten families with individual connections. Twenty-four other private connections serve schools, a health center, other institutions, and a single operator

[11] A twenty-eight year life was calculated by VIAK using a useful life of between 10 to 40 years on the various components of the system. Rural Water Evaluation, op.cit., Vol. 3 Annexes, Section 6/5.

TABLE 3

LEVEL OF SERVICE AND REVENUE FROM FOUR PROJECTS
1977 DATA

Scheme	Potential Consumers	Area Potential	Potential Consumers Km^2	Individual Connections		Kiosks	CWPs		% of Revenue Collected
				metered	flat rate		Start	Now	
Tetu Thegenge	67,500	High	450		889[b]	4[a]	125	4[a]	100[c]
Inoi	32,500	High→ Medium	400	95	791[d]		52	5	56
West Karachuonyo	44,000	Medium	245	19			64	50	15
Chepalungo	53,000	Medium→ Low	130		40		88	58	1

[a]By September, 1976, there were no communal water points or kiosks in operation. Since then 4 kiosks and 6 communal water points were opened.

[b]Mid-1976 data.

[c]Nearly 100 percent of the revenue is collected from the flat rate users at the rate of Shs 15/month. Nothing is collected from CWPs.

[d]300 connections have been requested but not installed because of lack of funds for materials to make the connections and a shortage of water to serve more users.

Source: Rural Water Evaluation, op.cit., Vol. 3 Annexes, Section 6/5.

of a water kiosk in the market center. The latter is at a higher elevation some distance away from the pump at the end of an extensive distribution network and, as a result, the supply is uncertain even when the pump is working.

Chepalungu is a system with an estimated 400 individual connections and no CWPs. There were 88 CWPs at the inception of the project but all are now closed.

Nyahera serves a community with 110 individual connections and no CWPs. It requires six persons to run the system. There are approximately 100 families living close to the pipeline who are not served by any communal facility.

C. Reported Impacts

A majority of respondents in the communities interviewed reported that reliable rural water systems improved health, increased income, had beneficial effects on women and children, and made the community feel progressive. Of the 22 communities, 10 reported benefits, 9 reported no benefits, and in 3 communities there was no consensus.

There was a statistically significant difference in self-reported health benefits in communities served with reliable and unreliable supplies. In those communities where there was a reported impact, improved health was always cited as one of the benefits. Of the communities that had reliable supplies eight reported either or both lower incidence of skin disease or less diarrhea, while two did not mention any change. Of the twelve communities served by unrelaible supplies, only two reported health benefits. (See Table 4.)

Other benefits reported were economic and social: increased agricultural production, time savings of "women and animals" who were then available for other tasks, more leisure or better conditions for women, improved classroom performance by school children, and an overall feeling of progress.

The reported impacts should be regarded with caution since they are not backed up with direct measures on health or on economic activity. It is, however, one indication of the value placed by people on an improved supply. Clearly, the available data shows that there is a significant difference in perception of benefits between users served by a supply that is reliable and one that is not.

TABLE 4

CONSENSUS[1] OF COMMUNITIES ON HEALTH BENEFITS: RELIABLE AND UNRELIABLE SYSTEMS

System Reliability	Number of Communities		
	Benefits	No Benefits	No Consensus
Reliable	8	2	0
Not Reliable	2[2]	7	3

[1] Where a person from the group of users assembled for the interview stated an effect on health and the others agreed it was considered a community consensus.

[2] Although one of the two supplies was categorized as unreliable a portion of the community was served reliably. The health benefits were reported only for the portion of the community that was reliably served.

TABLE 5

BENEFITS OTHER THAN HEALTH REPORTED BY COMMUNITIES

Benefit	No. of Communities Reporting
Increased Milk Production	3[3]
Increased Coffee Production	2
Availability of Women for Alternate Labor	2
More leisure and Better Conditions for Women	2
Availability of Draft Animals for Alternate Labor	1
School Children do Better in Class	1
Feel Progressive	1

[3] In one of the communities this is an anticipated benefit because cattle watering troughs are being constructed.

IV. SUSTAINABILITY

A disturbing number of rural water systems in Kenya have a very short life. Some never work well. Of the 23 systems visited, only 10 were proving to be reliable sources of supply. These included all categories of systems: those built by the MWD as their regular systems, self-help schemes, county council systems, and those built by private associations. The MWD has appointed a steering committee and appropriated $19 million for rehabilitation of water systems over the 1979-1983 period. A number of donors are supporting the effort -- CIDA, SIDA, DANIDA, the World Bank, CARE-Kenya and UNICEF.

Systems are not functioning because of problems in design, construction, operation and maintenance. While it is difficult to identify design and construction problems without a complete physical examination of the system, it is not difficult to assess the impacts of poor operation and maintenance. In the systems visited these included some systems that were out of fuel, engines not functioning because of lack of parts or service personnel, and leaking or missing valves.

Recurrent funds to operate a system have been estimated on an average at approximately 5 percent of the capital costs. This varies with system size and type. Gravity systems have the lowest costs while pumped systems require fuel and pump repair which increase the costs of operation. The operation and maintenance costs are continuous over the life of the project. When a rural water system is built a stream of funding must be provided for as long as the project is to operate. In a 10-year program building an equal number of systems each year, the 5 percent operation and maintenance component will be required on the cumulative investment. At constant prices this means that the 10th year budget for operation and maintenance will be 50 percent of the capital budget for that year. However, the 5 percent average needed must be increased as inflation increases the costs of operating and maintaining a system.

With fuel and other import costs soaring a 20 percent inflation rate would be reasonable. If a country is able to allocate a total of $10 million annually to capital investment and operation and maintenance, combined it would not be able to provide any new capital beyond the fifth year to insure that funds would be available to operate the systems in the tenth year. (See Table 6.)

The government has not provided the necessary funding. In 1978, recurrent funding was 8 percent of capital provided and represented less than 2 percent of cumulative assets. A 1979 investment of $16 million is matched by an increase of $176,000 on direct operating funds for fuels, chemicals, and maintenace expenses, just over 1 percent.[12]

[12] Estimate of Recurrent Expenditures 1979/80, Government of Kenya, p. 359.

TABLE 6

CAPITAL AND OPERATION AND MAINTENANCE COSTS OF A TEN-YEAR RURAL WATER SYSTEM
(in $ million)

Year	Investment	Operation and Maintenance	Cumulative Investment
1	10.0	.0	10.0
2	9.4	.6	19.4
3	8.6	1.4	28.0
4	7.6	2.4	35.6
5	6.3	3.7	41.9
6	4.8	5.2	46.7
7	3.0	7.0	49.7
8	1.1	8.9	50.8
9	-	10.9	49.9[1]
10	-	12.9	47.0[1]

Assumptions:

Maintenance takes priority over capital investment.
Inflation rate of 20% annually for Operation and Maintenance.
Maintenance starts in year two.
No offsetting revenues.

[1]Cumulative value of investment decreases because of lack of funds for maintenance.

Expenses for the operation of systems should be borne by those who are served. In the approved 1978/79 budget revenues from the sale of water from installation of new connections were expected to cover 20 percent of recurrent expenditures. The budget for 1979/80 projects that revenues will increase to cover 33 percent of costs.[13]

In the MWD the problems of operation and maintenance shortage is further complicated by the method of revenue collection. Funds paid by users do not revert back to the MWD but to the Office of the President. Some changes are contemplated. During the 1979-1983 period, the Ministry will assume full and direct responsibility for billing and collection of revenues from large water schemes. Medium and small schemes (presumably rural projects) will still be billed and the revenues collected by the Office of the President.

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[13]Ibid.

V. ANALYSIS

The rural water program in Kenya has gone wrong. In the light of the government commitment, why has so much investment brought reliable water supplies to so few people? There is no single answer to the question, but a number of lessons arise from the evaluation.

A. Lessons

A primary cause of the problem is the concept of a rural water system as a method of delivering piped water to individual metered connections. Whether this standard was adopted when SIDA provided funding in 1970 or whether this was the Government of Kenya's concept is not possible to determine. The concept is not always appropriate in Kenya. It leads to increased capital costs of systems, demands a higher level of design capability, more operational and maintenance funding, and an organization that can manage complex systems effectively. These preconditions do not obtain in Kenya.

-- There is a shortage of Kenyan engineers.

-- Capital costs are high. Estimates are that the cost per capita of universal service would be between $80 - $100 per capita based on present technologies and standards of service. If the current level of reliability and restriction of communal facilities continues, per capita costs for those adequately served will be between $320 and $400.

-- Two thirds of the MWD engineers are expatriates from varying backgrounds with short-term tenure. One third of the senior staff posts are either vacant or occupied by unqualified persons.

-- Operational and maintenance funding is inadequate.

-- The MWD has not yet sorted out its organizational structure. Regional offices are hampered by excessive control over purchases. Communication of regions with the district offices under their control and with the central headquarters is inadequate.

The policy that everyone should have access to an improved source of water and that all users will pay for the service is completely at odds with the actions of the MWD. The following contradictions are apparent:

-- No one consults the community before building the system to find out what the users want in the way of individual connections or CWPs so there is no basis for designing the system to meet the needs of the community. Indeed, CWPs are usually located to discourage their use. This is hardly a policy designed to encourage users of the community facilities to pay.

-- Communal water points are closed to encourage users to pay for individual service.

-- The cost of installing individual service is subsidized to encourage use yet the bureaucratic procedures required to get a connection discourage potential users.

-- Since individual connections are subsidized, users who have been "encouraged" to pay for this source must often wait for long periods because funds are not available for the portion of the cost subsidized by the MWD.

The number of users served by an individual system is large especially considering that the communities are dispersed. Average system size for the RWS I program was 5,000. The RWS II system had a design population of 9,000. Those RWS III systems completed through 1977 served an average of 40,000 users.

-- The size increases the design complexity since coverage includes an extensive area. Unless the area served is level, service points will be at varying heights above or below the intake causing a varying pressure gradient within the system. Devices must be installed to hold pressure within the working range of the pipes and fittings used.

-- Surveying and pipe installations must be carried out carefully to provide even gradients. If not, trapped air may interfere with the distribution of water.

-- The number of persons using each system is large and, as a result, more attention is required to ensure water safety than would be warranted if few persons used an individual system.

-- Systems must be designed to be more dependable since a single failure will mean large numbers of people not getting water.

-- The need for large amounts of water for each system restricts the use of wells as a source since it is claimed that there are few highly productive aquifers. The result is that nationally 63 percent of the systems use surface sources including nearly half from rivers and lakes where the potential for fecal contamination is high. Only 17 percent of the water was derived from wells.

The full range of technological choice has not been exploited in Kenya. If the country is ever to approach its goal of providing universal supply to all rural residents, groundwater sources should be exploited. There are traditional hand dug shallow wells in use. The use of improved shallow wells and handpumps should be encouraged.

B. Policy Implications

(1) Kenya has not matched the level of technology with the ability of the institutions to keep it functioning. Rural water projects require varying amounts of institutional support based on the technology used. At one extreme is the use of open shallow wells or protected springs. Such methods of improved supply can be installed and be reliable with little or no input from outside agencies. As the technology level becomes more sophisticated, the support required becomes more extensive. Where diesel pumps are used to distribute treated disinfected water a continual supply of spare parts, chemicals, fuel and trained people is required. Such re-supply must be carried out throughout the year regardless of seasonal weather conditions. Also, imported items such as parts and chemicals, often from hard currency areas, must be available.

An assessment should be made of what systems are currently being supported reliably by the existing agencies and projects should be designed at that technological level. Where other technologies are proposed which have not been reliable within the country or have not been used, specific provisions should be made to improve the ability of the institution to support the systems and take into account the complete range of services that must be provided to support the advanced technology.

(2) The Government of Kenya produces only a quarter of the funds necessary to support the systems installed. This is a reality and it should be assumed that the amounts of funding historically provided in any country are the amounts that will be available in the future. If systems cannot function at the level of support provided, other sources of funding must be provided or systems that can function at the level of support furnished should be designed.

(3) System reliability should be the primary concern of the Agency. If a reliable source of supply cannot be assured, then the system will be of little value. The reliability of supply can often be increased by installing more than one single well and handpump to serve a community or by providing standby pumping units for a pumped supply.

(4) Health and sanitation programs often considered essential components of improved rural water projects may not be necessary in some instances and should always be designed on the basis of what the community already knows and practices.

(5) The Harambee self-help program in Kenya mobilizes the resources and energy of the rural community. The schemes often are poorly designed and installed. Villagers literally spend years in the construction. Pipes and fittings are contributed by CARE and others on a piecemeal basis. AID could make a substantial contribution by providing the resources for self-help projects either on a regional or national basis. Since these are generally small schemes, they could be a proving-ground for small, well designed projects using groundwater and handpumps -- both neglected approaches in rural Kenya.

APPENDIX 2

REASONS FOR LACK OF RELIABILITY OF OBSERVED DIESEL SYSTEMS[1]

Community	Problem Cited		
	Design or Installation	Maintenance	Lack of Fuel
Magotio	X		
Chepalungo			X
Nyahera	X		
Raphedi	X		
Magunga			X
Aluor		X	
Bondo		X	
Manga	X		X
Gaithu			X

Of the nine diesel systems that did not provide a reliable supply of water, the principal reasons cited were poor design (four systems), poor maintenance (two systems), and problems with obtaining fuel (three systems). Fuel and system design were both considered equally important in one system.

Gravity systems were, in general, more reliable than those that were diesel pumped. Of the four gravity systems that were not reliable, two had inadequate sources of supply, one was plagued with problems of siltation and pipe breakage, and one had problems of both supply and distribution. While electric driven pumps were the most reliable, the sample size was too small to draw any conclusions.

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[1] The evaluation team was not capable of making an independent judgment on the merits of the complaints on system design. Problems of maintenance were also present in most, if not all, of the systems evaluated, but it is not a principal factor where fuel supplies are not regular or poorly designed systems make systems unreliable even when all parts are functioning.

APPENDIX 3

WATER DEVELOPMENT EXPENDITURE FOR 1978/79 - 1982/83

(In K£'000)

	1978/79	1979/80	1980/81	1981/82	1982/83	Total Plan Period
Headquarters, Provincial and District Offices	1,370	1,675	2,000	1,600	1,100	7,745
Rural Water Supplies	4,595	5,820	8,700	9,300	11,900	40,315
W/S for Livestock Development	3,104	1,940	2,500	3,300	3,400	14,244
County Council Water Supplies	100	100	100	100	100	500
Self-Help Water Supplies	1,720	1,940	3,000	3,000	3,000	12,660
Mombasa Pipeline Board	800	240	60	160	160	1,420
Mombasa and Coastal Water Supplies	8,605	4,850	3,400	2,300	3,800	22,955
Water Resources and Pollution Control	1,160	980	650	460	500	3,750
Urban and Service Centers Water Supplies	2,290	2,960	4,210	5,000	5,400	19,860
Sewerage and Sewerage Research	410	1,400	1,700	2,300	2,300	8,110
Water Conservation	440	800	550	550	600	2,940
Miscellaneous Water Programs	745	1,040	1,600	1,500	1,560	6,445
Rehabilitation of Water Supplies	290	1,500	1,600	1,600	1,800	6,790
Water Supplies for Integrated Rural Water Development	35	900	1,300	2,090	2,430	6,755
Training	59	165	200	220	250	894
Tana River Development Authority	12,845	14,190	9,430	6,520	1,700	44,685
TOTAL DEVELOPMENT EXPENDITURE	38,567	40,500	41,000	40,000	40,000	200,067

Source: Development Plan for the Period 1979 - 1983, Part I, Table 5.37.

Note: Material was taken directly from the source without editing. Mistakes in addition are in the original document.

APPENDIX 4
ITINERARY

WATER DEVELOPMENT,
P.O. BOX 30521,
NAIROBI

Ref. No.WD/1/2/37 Vol.II/10.

27th July, 1979.

Provincial Water Engineer,
Nyanza Province,
P.O. Box 1922,
KISUMU

Provincial Water Engineer,
Rift Valley Province,
P.O. Box 220,
NAKURU.

Provincial Water Officer,
Central Province,
P.O. Box 1343,
NYERI.

Provincial Water Officer,
Eastern Province,
P.O. Box 410,
EMBU.

VISIT OF RURAL WATER SUPPLIES IN YOUR PROVINCE
BY USAID OFFICERS

I have been requested by our Permanent Secretary's Office to introduce to you, Messrs. Daniel Dworkin and Ross Hagen of USAID who will be visiting your Province as detailed below to look at some of the public Rural Water Supplies operated by Ministry of Water Development.

You are requested to detail one of your Officers to accompany them on their visits to the Water Supplies in your Province.

These officials from USAID will make their own arrangements for transport, accommodation etc. but your Officer accompanying them will have to arrange for his transport accommodation etc.

Their itinerary is as follows:-

Monday 30/7/79 to Wednesday 1/8/79	Visit Rift Valley Province and stay at Nakuru Visit W/S around Nakuru
Thursday 2/8/79 to Monday 6/8/79	Visit Rift Valley Province and stay at Kakorok Lodge Visit W/S around Kericho.
Tuesday 7/8/79 to Wednesday 8/8/79	Visit Nyanza Province stay at Homa Bay Visit W/S in South Nyanza
Thursday 9/8/79 to Saturday 10/8/79	Visit Nyanza Province Stay at Kisumu Visit W/S around Kisumu.

.....2.....

Monday 13/8/79 to Tuesday 14/8/79	Visit Central Province Stay at Nyeri Visit W/S around Nyeri.
Wednesday 15/8/79 to Friday 17/8/79	Visit Eastern Province Stay at Embu Visit W/S around Embu.

You are requested to give these Officers assistance they may need in communicating with Water Consumers at the W/S they intend to visit.

(W. J. Odhiambo)
for: DIRECTOR, WATER DEPARTMENT.

c.c. Mr. Ndiho,
Ministry of Water Development,
NAIROBI. - Your letter no.WAT/OFTA/30 dated 9th July,1979 refers.

c.c. Mr. Daniel Dworkin,
C/o USAID
NAIROBI. (Attention: Louis Godela).

c.c. File No.WD/3/5/294.

APPENDIX 5

DESCRIPTION OF SELECTED RURAL WATER SYSTEMS SURVEYED

1. Lake Nakuru Settlement Scheme

The Lake Nakuru Settlement is in the Nakuru District of the Rift Province. The area has over 1,000 families. The population is served by a MWD water system consisting of two water motor generator sets, one serving as a back up system. The generator drives a submersible pump furnishing water to a 10,000 gallon storage tank. Source of water is a well.

The water is distributed from the tank by gravity to the three communal water points. Each water point has four taps. All parts of the system are in good working order. The only other source of water in the area is a small reservoir on the outskirt of the village area. This dries up in the period from January to April. The nearest source of water is then approximately 10 miles distant in either Nakuru or Njoro.

People were settled in the area in 1971. Each person has 10 acres of land. They raise maize, beans and tomatoes and have modest amounts of cattle, sheep and goats. The villagers complained to the District Commissioner about the lack of water as soon as they were settled. Three public meetings were held which produced no results. From that time on the complaints were continuous.

The first action taken was a survey by the Government in 1974. (It is not clear which government agency did the survey.) Construction was started shortly after. The villagers volunteered to dig the trenches. It is estimated that 500 persons worked on trenching although person days contributed was impossible to estimate. There were no consultations on the location of the taps which are clearly inadequate in number to effectively serve the 10,000 acre area.

The system is operated by the MWD which provides the fuel and the personnel. Six persons are employed. Housing for some of the people is provided in a fenced compound located at the borehole. Staff consists of an operator, two pump attendants, two inspectors and a laborer whose task seems to be to mow the lawn.

The system is completely reliable. Water is produced as scheduled all the time, but for only two hours daily--an hour each in the morning and afternoon. These restricted periods of supply are further aggravated by the pressure of a road construction crew who pre-empt one communal water point to fill a number of drums of water.

There is a substantial wait for water by the users who line up prior to the morning and evening period of supply. Alternative sources include a dam close to the village which sometimes dries up in the January, February and early March dry period and two adjoining villages, Nakuru or Njoro.

Restricted hours of operation seem to be the result of a policy of the former Regional Water Officer who was trying to encourage villagers to pay for private connections. The present Regional Water Officer had no knowledge of the situation.

While there is a restriction in water supply, there is a full complement of MWD personnel to run this system.

2. West Acre Pipeline

West Acre Pipeline is in the Nakuru District of the Rift Valley Province. The pipeline serves 96 families from a stream. Water is distributed by gravity. The system is operated by the MWD. Four people are employed in running the system. There is no water treatment and there are no functioning communal water points. All water users pay a monthly charge for water. Forty-five users have meters, 51 are billed on a flat rate basis.

The system is not dependable. During every rain the screens at the water intake silt up and must be cleaned to restore service. In addition, there are breaks in each of the two branch lines leading from the intake on the average of three times a month. When this happens service is interrupted for a day. Some spare parts for pipeline repair are maintained at the site. Another cause for complaint is the lack of water at some of the service points during high usage periods.

3. Sabatia Settlement Scheme

The Sabitia settlement is in the Baringo District of the Rift Valley Province. The area is predominantly rolling hills. The settlement scheme has allocated 35 acres to each plot on which farmers grow pyrethrum, coffee, wheat and maize. They also raise livestock with the average farmer owning 20 cattle.

The system distributes water by gravity. The water quality is poor, pipe breakage is frequent, and pressure is low. Operators rotate areas served so that consumers normally get water only part of the day. During rains the pipelines silt up and prevent water service.

4. Gathaithi Self-Help Scheme

The Gathaithi Self-Help Scheme is located in the Nyeri District of the Central Province. The area served was a former colonial estate taken over by the government and now cultivated by smallholders. The water scheme is not yet complete. It currently serves 3,000 families. Upon completion 8,000 families will be supplied.

Traditional water sources are small streams, a large river, springs, and an old hand drilled borehole. The borehole has collapsed and is no longer used. The other sources do not dry up in dry season and they have good quality water. The disadvantage in their use is the long distance that must be travelled to collect water.

In 1971 a committee was formed but little was done except to discuss the water problem. In 1975 a Harambee committee was formed and the project was formally started.* The Harambee committee raised 271,000 KShs and the Ministry of Water Development has contributed 90,000 KShs worth of pipes and 100,000 KShs in materials for storage tanks. Planning for the system was done jointly by the committee and the MWD. Labor for trenching and construction of the storage tanks was volunteered by the villagers.

The system used an electric driven pump drawing water from the river. Water is pumped to two 20,000 gallon storage tanks from which delivery is by gravity. To date, there are 1,200 individual connections. Villagers who do not have connections use their neighbors'. Water is available for 24 hours/day for 6 days of the week; there is no pumping on Sunday. In 1979, the village raised 221,000 Kshs for project extension and MWD promised 330,000 KShs for a filtration tank.

One man is paid a salary to run the pump and repair any pipe breaks (1 or 2 per week). There are parts for pipe repair on hand, but pump repair must be done in Nairobi. Normally one day is required to repair a broken pipe. During this time no water is available in that section of the system. On the average one week is required for pump repair. Once in two months the whole delivery system is shut down for pump repair.

At present there is no charge for water. If money is needed for system repair or electricity costs it is raised by Harambee effort. A 15 KShs/ month charge for each household has been proposed to cover the operation costs which are running 1,000 KShs for electricity alone. For the very poor water will be free.

There has been instruction on the health benefits of using clean water. The major benefits from the system have been increased water use resulting in improved health and time savings. With the time saving donkeys used for carrying water can work longer in the fields.

*The members of the community have had prior experience in organized activity in construction of schools, churches, cattle dips, and nursery centers.

5. Kaburaini

Kaburaini is located in the Central Province, Nyeri District, and has a population of about 2,500 persons. The main sources of income in the community are dairy production, maize, and pyrethrums. Some sheep and goats are raised and everyone has a large flock of chickens. The average landholding is less than 10 hectares with the largest landholder having about 66 hectares.

Traditional sources of water were rivers which flowed all year round. The closest river was 4 miles away from most people. At one time there was a borehole with a pump and engine.

In 1970 the women's group in the village collected some money and then went to the government for assistance.* The Ministry of Water Development assigned a US Peace Corps volunteer to assist the project. European settlers had made a survey of the area in 1941 and had planned to improve the land with piped water. This plan was used as a guide in the layout of the present system. Construction of the intake began in 1972 with trenching and pipe laying beginning in 1974. At present, the system has 66 kms of pipe network serving 20 communal points and less than 100 individual connections. The project is in progress with the community doing all the work and MWD personnel providing supervision and technical assistance when needed.

Profits from the dairy cooperative are used to pay for needed materials. Each individual is given 40 feet of pipe and the necessary fittings for a connection free. If more pipe is required it must be purchased by the individual. Once the project is completed the profits from the dairy cooperative will be used to operate and maintain the system.

Water is available 24 hours/day but the ends of the lines have low pressure. Since most of the lines are still being extended; the ends of the lines are not capped and water flows continuously.

The community reports pipe bursts to the construction forman who is a villager and is paid 15 KShs per day to supervise the continuing construction and repair of pipes. There is a store of parts at the water committee headquarters. To date, no outside help has been required for system maintenance. If it should be required the MWD will furnish the technical knowledge needed free-of-charge and can also furnish spare parts not available locally.

There is no charge for water because the profits from the dairy cooperative pay for operating and maintenance expenses.

*The village has a history of cooperative associations. The women's group was originally formed to improve the homes. Water was felt to be one of the most important improvements.

The Ministry of Social Services has a person stationed in the village and he gives instruction on health to the community. Benefits have been improved health. Because water is more readily available more is used for bathing and washing. Time saved by the closer source is used for more farm work and increased leisure. It is felt that with the construction of cattle troughs there will also be an increase in milk production.

6. Bondeni

Bondeni is located in the Central Province, Nyeri District, and has a population of 5,000 families. The main source of income is from dairy production and potatoes. The average landholding is 7 acres with the largest landholder having 25 acres. Cattle and sheep are the main livestock kept.

The traditional source of water was the river at 2 km distance from the furthest villagers. The river flowed all year round and the water quality was good.

The people came together and discussed the water problem. In 1975 a Harambee committee was formed, 7 women and 4 men, and money was collected.* The planning was done by the MWD and the committee. The people knew the scope of the project before construction started later the same year. The villagers contributed labor for tenching, pipelaying, and construction of storage tanks and the pumphouse. The system uses an engine driven centrifugal pump drawing water from the river. At present there is one communal water point, two more CWPs are to be constructed, and 82 individual connections. The project is continuing to be expanded, the plan is for everyone to have an individual connection. Each individual must pay for the materials needed to deliver water from the main line to his plot and do the work.

Water is available 24 hours a day. The committee has a salaried pump attendant who also handles maintenance. There is no stock of spare parts. When repair is required the District MWD office supplies parts and the required expertise free of charge. There is no charge for water as such; each household pays 20 KShs per month for diesel fuel purchase regardless of whether or not they have an individual connection.

People for the MOH visit once a week at public meetings and give talks on health. The villagers feel that health has improved as a result of better hygiene. Time saved by the more convenient source of water is used for work in the fields and other jobs in the home. The people also feel better developed since they now have water near their homes.

*The village has a dairy cooperative and has used Harambee to construct schools and cattle dips, however none of the organizations were involved in the water project.

7. Tetu Thegenge

Tetu Thegenge is a Ministry of Water Development project located in Central Province, Nyeri District, and is designed to serve 76,000 persons. The people served are primarily farmers with the main cash crops being coffee and pyrethrum. The average landholding is 6 acres with the largest landowner having about 20 acres. Some cattle are also owned by most people.

Traditional sources of water were rivers which did not dry up in dry season. The average travel distance to one of the rivers was one mile. Water quality was poor because the rivers had a high silt load.

The improved water system was constructed in 1975. This is a gravity system delivering river water to 2,380 individual connections. Twenty-two of these connections are metered with the remainder paying a flat rate. The unmetered connections are believed to be serving about 30 persons. Because the river flow decreases significantly in the dry season, January, February and August, the zones at the ends of the lines or at higher elevations often do not get water for 2½ weeks at a time. An attempt is made to ration water; zones are cut off to allow other zones to get adequate pressure. For the best area the longest period of constant water is six months.

Planned availability of water is 24 hours/day, however this is not what is actually available.

System maintenance is done by the MWD. There is a charge for water, 15 KShs per month for flat rate, but the people do not like to pay because the water is unreliable.

Health instruction is given by the MOH and Administration of Social Services. Benefits for those who have water include an improvement in hygiene because of increased water use and a decrease in labor because the women no longer have to carry heavy containers of water.

8. Ruiri

Ruiri is located in Eastern Province, Meru district, and has a population of about 15,000 persons. The major economic activity is farming with coffee and cotton production generating the largest revenues; some livestock are also raised. Since this is a settlement scheme, there is no disparity in land distribution; everyone has about 15 acres.

Traditional water sources consisted of two salt licks with saline water and a nearby stream which dries up in August and September. During dry season the salt licks are used or water is hauled from a town 11 km away.

Because of the shortage of water during coffee harvest, the coffee had to be hauled to town for pulping. In one year 150,000 KShs was lost because of a lack of transport.

In 1971 a Harambee committee was formed and collected 21,000 KShs.* The committee secretary at that time approached the Italian Government for assistance and in late 1971/early 1972 received 1,500,000 KShs worth of cast iron pipes. The Italian Government also provided some engineers to assist in project design. 50,000 KShs was also received from a Dutch private donor organization. Construction was started in 1972 with the first people receiving water in 1974/75. Currently, 2,500 persons are receiving some water. The currently used source, a 100,000 gallon storage tank, has never been half-full, but the water quality has been good. The source is a mountain stream with a gravel bed and there has been no siltation problems. Because of the water shortage, water is rationed among the different sections with each having water one-quarter to one-half hour per day. During dry season some people only get water once or twice a month.

Because of the water shortage the committee has taken steps to improve and expand the system. In 1974, a 700,000 KShs loan was obtained from the Cooperative bank. The Dutch government has provided 1,500,000 KShs worth of pipe (6 and 8 inch diameters), and CARE/Kenya has provided 163,000 KShs in pipes and materials to date, with more promised. The committee has continued to work with the Ministry of Water Development on the design of the system. The intake is to be moved to a better water source high in the mountains and the expansion is expected to cover a 152 km^2 area leaving 25 km^2 of the village area without water.

Gate valves are located on all branches of the main line. Therefore, when there is a broken pipe, one at least every 3 months, only the section affected is turned off. Pipes are repaired by the community; the cast iron pipes are taken to a nearby village for welding then are reinstalled. Two people are paid by the committee to maintain the system. More are needed but two are all they can afford to pay. No spare parts are kept in stock but they are purchased when they are needed.

There is a charge for water but some very poor are given water free. 8,000 persons have been required to pay 150 KShs per year for 5 years to repay the loan from the Cooperative bank and operate and maintain the system. This loan will be repaid this year and the committee has scheduled a meeting to decide on the charges required for operation and maintenance. The committee has the power, and has used it in the past, to confiscate property of those who are able to but do not pay the water fee. This property is sold to raise the required money. Permission for this action is requested from the District Commissions.

*A priest at a nearby Catholic mission has given the committee information on possible donors to contact for assistance and assisted them in establishing the contacts. This was the first organization established in the village.

The major benefit from the project has been a decrease in the losses caused by a lack of water to pulp coffee. With several nutrition training centers nearby there have been frequent visits from Ministry of Health personnel. The people perceive improved health among those that have water.

9. Kibirichia

Kibirichia is located in Eastern Province, Meru district, and has a population of about 17,000 persons. The Kibirichia Water Development Association is to serve the entire population. The sublocation with a potential service population of 3,000 was visited. The major economic activity is farming with dairy, potatoes, wheat, and pyrethrum production being the major income producers. The average family landholding is 8 acres with the largest landowners of the community having 20-23 acres.

Traditional source of water was two furrows built by an European farmer long ago. In 1920, the two furrows were joined when a severe drought caused one to dry up; since then there has been no water shortage. There is no other source of water in the area and most people are 2-3 miles from the furrows.

In 1964, a committee was established to pipe water from one of the existing furrows.* Money was collected from the association membership at 10 KShs each. The Ministry of Health and UNICEF were contacted and some 1 ¼ inch diameter pipe was supplied. Three storage tanks were built with UNICEF aid. The pipelines were surveyed by the MOH and the association members did all the trenching and pipe laying themselves in 1964. About 180 people are receiving some water. Because of a water shortage, water is rationed between sections; the water is given to each section one week at a time. Many people have individual storage tanks which are filled when they have water. According to the District Water Office the main cause of the water shortage is that four villages are drawing from the same source.

In 1971, the committee decided to upgrade the system. They collected 200 KShs per family from those using the water and bought 1,000 3-inch diameter pipes. The project then came to a halt because of a lack of money. Recently the whole sub-location had a meeting and decided to set up a committee combining with another sub-location. Each sub-location contributed 40,000 KShs which was matched with 40,000 KShs from the Kenya Government (total 120,000 KShs). The plan is to bring water from a more distant river via a new furrow and one of the original furrows. The river to be tapped is larger and has good quality water with no sediment load.

*The village has a history of cooperatives activity and there are many cooperatives in the village for collecting and selling farm produce. Everyone belongs to some type of cooperative.

According to the DWO the problem of overcommitment of the river water will still exist. The MWD has been working with the four villages involved to reach a resolution on water allocation; to date none has been reached. No construction will start until an agreement has been reached.

Maintenance of the furrow and pipe network is done by the association members. There is some problem with livestock getting into the furrow but this is to be corrected with the installation of cattle troughs. There is no maintenance person; whomever finds a break reports to the committee chairman who calls on association members for help. Parts are purchased as they are needed; none are stocked. If outside help is needed, for cutting pipe, it is paid for by job. There is no charge for water. When needed, money is collected from members.

The major benefits of the project have those in dairying. There has been a noticeable increase in milk production with nearer supply of water. Ministry of Health has a person stationed permanently in the village who discusses benefits from using clean water. People perceive an improvement in the number of skin diseases.

10. Taitu

Taitu is located in Eastern Province, Meru district, with a population of 8,000 - 10,000 persons. The major economic activity is farming with coffee, cotton, and sunflowers providing the most money; some livestock is also raised. There is a noticeable shift to grade cattle from native breeds as water becomes available. The average landholding is about 20 acres with the largest landholder having about 60 acres.

Traditional water source was a river; the same one is used for the improved system. The river is reliable and has good quality water in the dry season (August and September, and February to mid-March). During rainy season the water is dirty.

The Taitu Water Project was started prior to 1970 by the Ministry of Health. A Harambee committee was established and money was collected. The community members did the construction of the system with some assistance from the District Development Committee. The MOH first installed a hydram which failed to provide enough water. They then installed a 7.5 hp diesel engine and pump which also failed to provide enough water. The DDC then provided the present 29.9 hp engine which also does not supply enough water. A 50,000 gallon storage tank has been built but there is not enough water to fill it. About 400 families get water intermittently. Some water is used for livestock. There has been no problem with pump or engine but they often lack money for fuel and to hire a pump operator. There is no fee for water; money is collected to buy fuel and if there is enough one person is hired to patrol the lines. There are no spare pipes or parts.

The District Water Office says the problem is in the sizing and slope of the pipeline. The engine and pump would have been sufficient for the system if it had been correctly constructed. The river is more than adequate.

In 1975, the Kaguma Water Association was formed to build a gravity system using a furrow as the main line. The people decided to start the gravity scheme because of the inadequacy of the pump system. They were aware of the problems others had with the pump systems and also realized that purchase of diesel fuel would be a continuing problem. A weir in the river diverts water into the furrow. The Ministry of Water Development surveyed the proposed furrow line and checked the plans for the weir intake. Construction started in 1975 and water was delivered to the home from the furrow. About 200 families are served at present. The furrow is cleaned and maintained by the association members. No fees other than the association membership fee, is charged for water. To date, there have been no major problems. About once a year high stream flows in rainy season washes rocks and mud into the intake; this takes about two hours to clean.

There are a number of benefits reported by the users. The one that is most valued is the chance to shift to high grade cattle from local stock when the water supply is completed. At present, the villagers state that schools are healthier because water is used to sprinkle on the floors thus suppressing dust. Also the children do better in class becuase there is more water to drink. In addition, the health of the entire community has improved. Skin disease has noticeably decreased because of a MOH program emphasizing personal sanitation.

The two systems have an overlapping membership and a meeting has been held to merge the two organizations into one organization with two committees, one for the gravity system and one for the pump system. The new organization will be an association so everyone must contribute for the membership fee. Contributions can be money, material, or labor. A Harambee is scheduled for September or October, after coffee payout, to raise money so membership fees can be kept low. The goal is to extend the gravity system to everyone in the village and phase out the pump system.

11. Central Abothoguchi Water Scheme

The Central Abothoguchi Water Scheme is located in Eastern Province, Meru district, with a potential service population of about 10,000 persons. The major economic activity in the area is farming with coffee, cotton, groundnuts, and dairy providing the most income. The average landholding is 5 - 10 acres with the largest landowners having about 60 acres.

The traditional sources of water are nearby rivers and springs which dry up in August and September. At that time people must travel up to eight miles to a river which always flows.

In 1975, a licensed Harambee was formed to raise money. This organization was later converted into a formal society so that entrance fees and share purchases could be required. At present potential members must pay a 100 KShs entrance fee and buy a share at 2,000 KShs in order to get water. Shares can be obtained by contributing materials or labor in lieu of cash.* For the very poor of the community each case is decided on its own merit; if deemed worthy, water is free.

Planning for the system has involved the Ministry of Water Development, CARE/Kenya, and the society members. The society paid for the transport of MWD surveyors from Embu because of a MWD vehicle shortage. The first people received water in 1978 and about 2,000 persons are receiving water at present. Many members having purchased the pipe necessary to get water from the main lines to their households. The system intake is a nearby river with a weir. Six inch pipes deliver water by gravity flow to a 30,000 gallon storage tank. There are two 5,000 gallon storage/ break pressure tanks in the line which have secondary lines running off. There are five lines radiating from the large storage tank. The society members did all the trenching, tank building and pipelaying with MWD supervision. The water quality is good all year round; the river has a gravel bed and no silt load.

The major benefit has been the opening of a health center in 1978 when water was supplied. The center had been constructed in 1963 but never used for lack of water. The Provincial Medical Officer would like the water to be treated but the society feels that is too expensive. They feel the first priority is to get water to everyone. There has been some increase in milk production from those having grade cattle.

12. Crater Valley Scheme, Bahati (Not included in sample calculations)

The Crater Valley Scheme, Bahati, is located in the Nakuru district of the Rift Valley Province. The location is a rich coffee-growing area with predominantly large plots of land, one of which was subdivided for a settlement scheme. The scheme was built during the colonial period to serve 14 farms. One of the smallest is 550 acres. Two years ago MWD took over the scheme. Pipeline situation is a problem during the rainy season.

*Money can be pledged and later deducted from receipts from the sale of produce through one of the marketing societies. The societies are voluntary organizations for transporting and selling members' produce. Profit is divided among members or used for community benefit.