Drylands Research Working Paper 3

MAKUENI DISTRICT PROFILE: WATER MANAGEMENT, 1989-1998

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Preface

Drylands Research Working Papers present, in preliminary form, research results of studies carried out in association with collaborating researchers and institutions.

This working paper is part of a study which aims to relate long-term environmental change, population growth and technological change, and to identify the policies and institutions which are conducive to sustainable development. The study builds upon an earlier project carried out by the Overseas Development Institute (ODI) in Machakos District, Kenya, whose preliminary results were published in a series of *ODI Working Papers* in 1990-91. This led to a book (Mary Tiffen, Michael Mortimore and Francis Gichuki, *More people, less erosion: environmental recovery in Kenya*, John Wiley, 1994), which was a synthesis and interpretation of the physical and social development path in Machakos. The book generated a set of hypotheses and policy recommendations which required testing in other African dryland environments. Using compatible methodologies, four linked studies are now being carried out in:

Kenya	Makueni District	
Senegal	Diourbel Region	
Niger	Maradi Department	*(in association with ODI)*
Nigeria	Kano Region	*(in association with ODI)*

For each of these study areas, there will be a series of working papers and a synthesis, which will be reviewed at country workshops. An overall synthesis will be discussed at an international workshop in London in 2000.

The Kenya series updates the previous study of Machakos District (which included the new Makueni District) and examines this more arid area in greater depth. The Research Leader for these studies is Michael Mortimore. The Leader of the Kenya Team is Francis Gichuki of the University of Nairobi. Michael Mortimore, Mary Tiffen or Francis Gichuki may be contacted at the following addresses.

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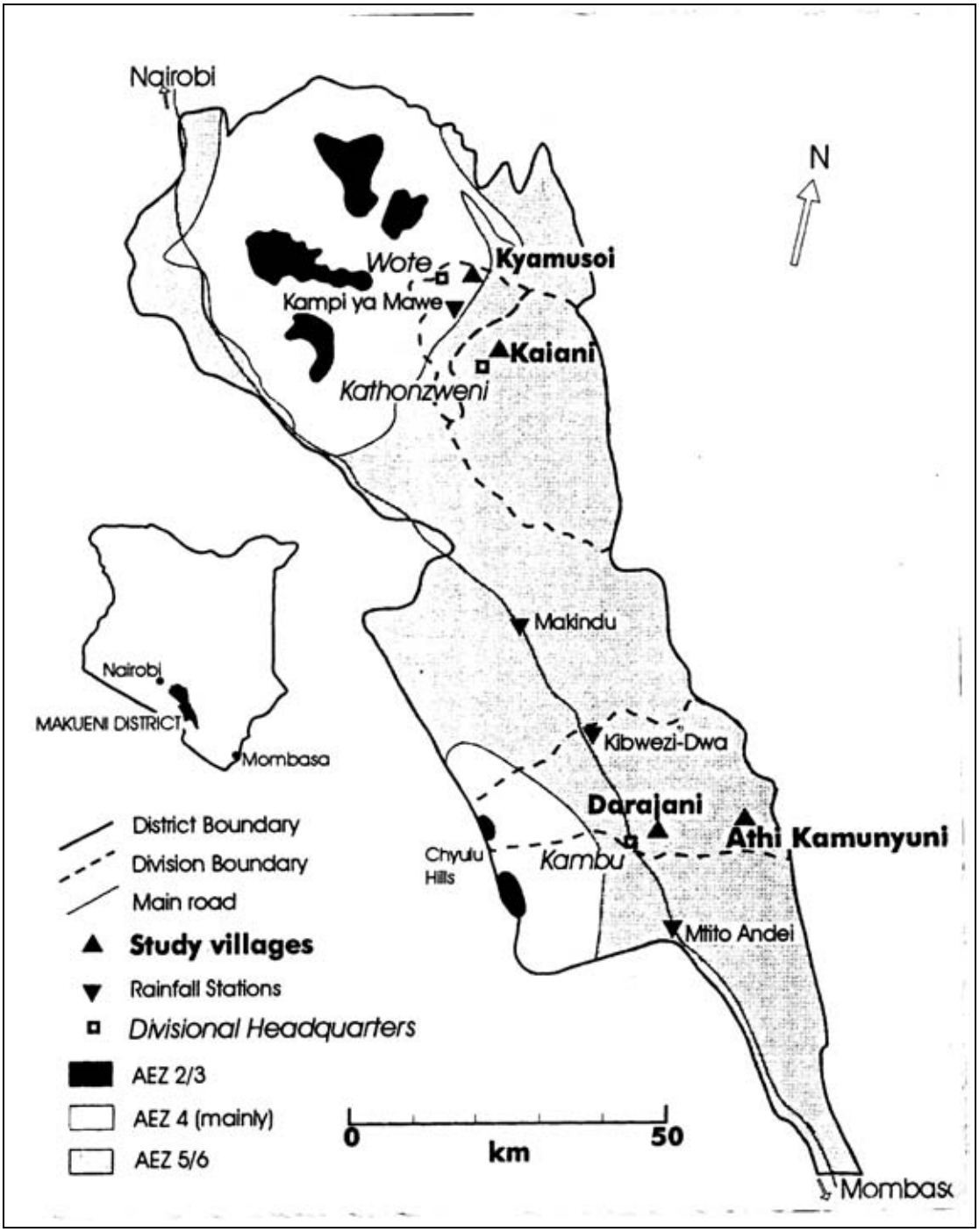
Preface map


Nairobi
N
Wote
Kyamusoi
Kampi ya Mawe
Kaiani
Kathonzweni
Makindu
Nairobi
MAKUENI DISTRICT
Mombasa
Kibwezi-Dwa
Darajani
Athi Kamunyuni
Chyulu Hills
Kambu
Mtito Andei
District Boundary
Division Boundary
Main road
Study villages
Rainfall Stations
Divisional Headquarters
AEZ 2/3
AEZ 4 (mainly)
AEZ 5/6
0
km
50
Mombasa

Abstract

This document uses data surveys carried out in four villages in Makueni District, Kenya and the available literature in order to assess the water constraints faced by its residents. It documents individual and community initiatives, approaches, and technologies, and the external interventions and policies that have facilitated investment in water management by households. In all areas, there has been a move towards the development of private water sources. Since settlement, rivers have diminished in importance as water sources relative to communal water sources (dams, boreholes and gravity-fed water supply) and more recently to private water sources (individual farm ponds and roof catchments), reflecting increased household investments. The Government has continued to subsidise water users, but has started the process of handing over some of the gazetted rural water supply systems to farmers. The institutional and legal framework governing access to and governmental investment in water resources is set out, and the issues that have resulted in the main policy changes are summarised. One of the major changes is the privatisation of water supply systems. In Makueni District investments in water management have been made by households to serve domestic agricultural requirements. Cyclic government investment in the construction and rehabilitation of the water supply infrastructure is now being replaced by more continuous investment under community management, where water fees cover the total cost of operation and maintenance.

Résumé

Ce document utilise les résultats des études qui ont été menées dans quatre villages du district de Makueni au Kenya ainsi que les publications disponibles afin d'évaluer les contraintes que subissent les habitants au niveau de l'eau. Il examine les initiatives individuelles et collectives, les différentes approches et les technologies utilisées afin d'alléger ces contraintes, ainsi que les interventions externes et les diverses mesures qui ont permis aux familles d'investir davantage dans l'exploitation de l'eau.

Dans la majeure partie de ce district l'eau y est rare. Les principales sources d'approvisionnement en eau sont les rivières, les points d'eau, les forages, les puits peu profonds, ainsi que les réservoirs construits par les hommes. La grosseur des rivières varie selon les endroits et la saison. Beaucoup ont un gros débit pendant les saisons des pluies mais sont sèches le restant de l'année.

Presque tous les agriculteurs et les administrateurs du district consultés ont été d'accord sur le fait la plupart des systèmes d'alimentation en eau fonctionnent mal ou sont surexploités. La liste de quelques uns des principaux problèmes se trouve dans la partie 2.3.

Afin d'analyser les changements qui ont lieu au niveau de l'importance relative des différentes sources d'approvisionnement en eau pour les familles des populations rurales, il a fallu établir quelles étaient leurs principales sources d'approvisionnement au moment de leur installation et pendant la durée de cette étude (1998). Celles-ci sont indiquées dans la figure 2. Lorsque les familles s'installent, ce sont les rivières qui constituent leur principale source. Dans toutes les régions, les familles essaient de développer des sources d'approvisionnement privées. Aller chercher et vendre de l'eau

est devenue une affaire rentable, particulièrement à Darajani et à Athi Kamunyuni où il n'y a pas eu de projet de créer des systèmes d'alimentation en eau communautaires. Dans l'appendice II, divers projets dont l'objectif était la construction de barrages pour un usage collectif, privé ou entrepris en partenariat, sont examinés.

Après la période d'installation, les familles utilisent moins les rivières et davantage des sources d'approvisionnement communautaires (barrages, forages et systèmes alimentés par gravité) et plus récemment privées (bassins privés dans les fermes et installations pour recueillir l'eau de pluie des toits), ce qui montre bien que les familles investissent plus dans ce domaine. Dans les zones semi-arides, les principales sources d'alimentation en eau sont à l'heure actuelle: les rivières, les barrages collectifs, les installations pour recueillir l'eau de pluie au niveau des toits, les barrages privés, et les forages.

La distribution de l'eau revient cher car les populations sont dispersées. Les tarifs des systèmes communautaires actuels pour l'alimentation domestique sont établis de manière à ce que les plus pauvres puissent être approvisionnés, mais ne garantissent pas toujours les frais de l'entretien. A Wote et Kikumbulyu, les frais de fonctionnement et d'entretien des services des eaux officiels sont plus élevés que les revenus qu'ils rapportent (Tableau 8). Le gouvernement par conséquent continue à subventionner la consommation d'eau des familles. Il commence récemment à confier aux agriculteurs la charge de certains systèmes d'alimentation en eau qu'il gérait auparavant. Aussi les coûts en eau de projets concernant l'établissement de systèmes d'approvisionnement communautaires varie selon les projets. Des détailles se trouve dans le Tableau 4.

30 pour cent des agriculteurs ayant participé à notre étude utilisent un supplément d'eau pour pouvoir cultiver des légumes et des arbres fruitiers. La plupart vivent à 2-3 km des rivières. Un examen de la situation de ceux qui ont été interrogés ou de ceux que l'ingénieur chargé de l'irrigation a questionné se trouve dans l'appendice III.

L'étude examine le cadre législatif et institutionnel dans lequel est organisé l'accès de la population aux sources d'approvisionnement en eau ainsi que les investissements faits par le gouvernement au niveau des ressources disponibles. La liste des problèmes qui se posent à la suite de changements dans la politique suivie se trouve dans les tableaux 5 et 6. Les modifications au niveau des directives, des stratégies et de la politique suivie en ce qui concerne l'irrigation dans les petites exploitations sont énumérés dans le Tableau 7. Un des changements le plus important dans la politique du gouvernement a été la privatisation des systèmes d'alimentation en eau. Dans les zones rurales, cet objectif devait être atteint en confiant la charge de ces systèmes aux communautés locales et en créant les conditions nécessaires à leur participation.

Dans le district de Makueni, les investissements au niveau de l'exploitation de l'eau ont eu l'objectif de satisfaire les besoins de la population et de l'agriculture. Les pouvoirs publics ont investi de manière cyclique, principalement pour la construction et la remise en état des systèmes, plutôt que pour leur fonctionnement ou leur entretien. Cet investissement qui était auparavant cyclique devient de plus en plus un effort continuel qui est géré par les communautés et où les revenus sont suffisants pour pouvoir financer dans la totalité le fonctionnement et l'entretien des systèmes.

CONTENTS

Author's acknowledgements

Many people have contributed to this work by providing data, help, advice and direction. I am indebted particularly to the farmers who took time off their busy schedules to participate in the study by sharing their experiences and allowing me to interfere with there privacy by sometimes asking very personal questions and taking measurements in their fields. I am equally grateful to the district staff, particularly Mr. M. I. Kamami, the District Irrigation Engineer, who assisted me in accessing their data rich files and sharing their experiences and ideas. Thanks also go to the University of Nairobi for giving me time off to undertake this study.

About the author

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List of acronyms and abbreviations

ADC:	African District Council
AEZ:	Agro-ecological zone
ALDEV:	African Land Development Board
ASAL:	Arid and semi-arid land
GAA	German Agro Action
IL:	Inner lowland
Ksh:	Kenya shilling (approximately 70 Ksh = 1 US$, April 2000)
LM:	Lower midland
MAP:	Makueni Agricultural Programme
MIDP:	Machakos Integrated Development Programme
MISP:	Makueni Irrigation Support Project
MoWD:	Ministry of Water Development
MSIP:	Makueni Smallholder Support Development Project
PPCSCA:	Permanent Presidential Commission on Soil Conservation and Afforestation
SIDP:	Small-scale Irrigation Development Unit
SISDO:	Smallholder Irrigation Support Development Organisation
WUAS:	Water Users Association Support Project

INTRODUCTION

1.1 Background

Water is a basic need and an important catalyst for accelerating socio-economic development in semi-arid areas. Proper management of water resources is therefore a prerequisite to rural development. This component of the Makueni study aimed at improving our understanding of water management initiatives and how government policies have influenced investments in water management by small-scale farmers and communities.

1.2 Objectives

The overall objective of the water management component of the study is to construct a profile of water management for the semi-arid areas of Makueni District. This is achieved by:

1. reviewing literature on water management issues;
2. documenting individual and community initiatives, approaches and technologies used to alleviate water constraints; and
3. document interventions and policies that have facilitated farmer investment in water management.

1.3 Methodology

The study was carried out in the semi-arid areas of Makueni District. The study focused on four study areas, namely: Kyamusoi village in the marginal cotton zone (LM 4) Kaiani and Darajani villages in the sorghum/millet/livestock zone (LM 5) and Athi Kamunyuni village in the livestock zone (IL 6) (see Preface map). The characteristics of these study sites are summarised in Table 1.

For each study area a group interview consisting of 6-12 farmers was conducted to establish changes in water situation and community responses to these changes. Twelve respondents for each village were selected at random for detailed interviews. Specific water management issues were addressed through:

1. analysis of secondary data on rainfall, drought and on activities of soil and water conservation, livestock and domestic water, irrigation and afforestation projects;
2. oral history, reconstructed through group and individual interviews, is used to trace sequence of change and dominant causal factors influencing settlement dynamics, changes in land use and tenure, investments in soil, water and tree management;
3. farm level observations, interviews and measurements; and
4. district level interviews with subject matter specialists.

Table 1: Characteristics of study sites

	Kyamusoi	Kaiani	Darajani	Athi
AEZ*	LM 4	LM 5	LM 5	IL 6
Time of settlement	*1950s*	*1960s*	*1960s*	*1970s*
Mode of settlement	Government supported settlement	Spontaneous settlement	Spontaneous settlement under govt guidance	Spontaneous settlement
Predominant land use	Cultivation cattle	Cultivation cattle	Cultivation beef cattle	Cultivation goats
Access to market	Good	Good	Good	Poor
Administrative division	Wote	Kathonzweni	Kibwezi	Kibwezi

*Lower midland (LM) zones extend over an elevation of 800 to 1300 m in Eastern Kenya and have an annual mean temperature of 21-24^{o}C with a minimum temperature greater than 14^{o}C. LM4 is a marginal cotton zone with an annual average rainfall 40-50 percent of potential evaporation. The climatic conditions are fair to poor for cotton and maize, fair for pigeon peas and good for sisal. LM5 is a lower midland livestock-millet zone with an annual average rainfall 25-40 percent of potential evaporation. The climatic conditions are fair to poor for millet, cowpeas and sisal. The natural pasture can support low density grazing. IL6 is an inner lowland ranching zone not suitable for rainfed crops and with natural pasture that can support low to very low grazing density (Jaetzold and Schmidt, 1982).

2 CHALLENGES IN WATER MANAGEMENT

2.1 Water scarcity: a recurring phenomena

Water is a basic need and an important catalyst for accelerating economic development in semi-arid areas. Surface and groundwater resources in these areas are unevenly distributed, both in space and time. An increase in human activities increases the demand for water, and may result in the degradation (reduced quantity and quality) of water resources.

The semi-arid areas of Makueni District fall in Kenya's water sub-catchment 3F. The main rivers that drain this sub-catchment are the Athi, Kaiti, Kikuu, Kiboko, Makindu, Mukononi, Kibwezi, Masongaleni, Kambu, Mtito Andei, Kenani and Thavu rivers. Of these the Athi, Kiboko, Kibwezi and Masongaleni are perennial rivers. All traverse the district from west to east and drain into the Athi river, which forms the Makueni-Kitui district boundary. The annual water yield of sub-catchment 3F is estimated as 26 million m^3 (IDB, 1993). Perennial rivers are 5- 30 km apart. In 1994 water shortages were reported to occur in one out of five years (IDB, 1993). The situation has deteriorated due to increasing human, livestock and irrigation use.

The Chyulu range is the most important water catchment for both surface and ground water. Ground water resources are available at depths ranging from 10-100 metres. The high cost of drilling wells and boreholes, and pumping constrains the use of the groundwater resources in most areas.

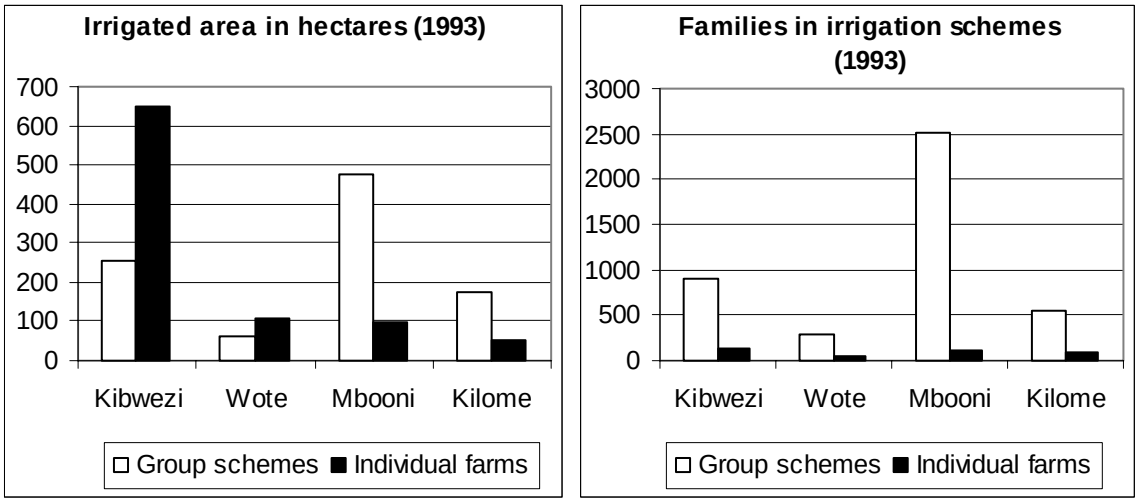
In most of the district, water is considered to be very scarce. There is also a high spatial and temporal variability of the river water resources. The ephemeral rivers carry high flows during the rainy seasons and are completely dry during the dry seasons. Perennial streams and springs offer potential for pump and gravity fed irrigation farming. The major sources of irrigation water in the district are rivers and springs. On a smaller scale irrigation water is abstracted from boreholes, shallow wells and man-made reservoirs.

2.2 Irrigation issues

In Makueni District, irrigation development is seen as a vehicle for increased levels of employment, income, food production and health standards. Makin and Pratt (1984) argued that irrigation was required to sustain a high population density in semi-arid and arid areas (Table 2). Irrigation labour requirements are 2-4 times higher than for dryland agriculture, crop yields in irrigated fields are 2-5 times those of non-irrigated fields, and gross margins of irrigated crops are 5-10 times higher than for non-irrigated crops in drylands (MISP project proposal document).

The status of irrigation in the district is documented in an IDB irrigation profile. This was aimed at prioritising public irrigation investment. The irrigated area in the district is estimated as 1,866 hectares, and the untapped potential is estimated as 1,123 ha. The distribution by division and by irrigation scheme type is presented in Figure 1. In the group schemes, the average irrigated area per family is 0.23 ha for the district and 0.28, 0.22, 0.19, and 0.32 ha for Kibwezi, Wote, Mbooni and Kilome Divisions respectively. Most of the untapped potential is in Wote and Kibwezi Divisions (IDB, 1993).

Figure 1: Irrigation area and farm families



Source: IDB, 1993.

Table 2: Rainfed/irrigated crop yields on small holdings in Kibwezi Division (t/ha)

Crop	Rainfed	Irrigated
Maize	0.2-0.9	2.5-4.0
Beans	0.2-0.7	1.1-2.0
Cotton	0.2-0.8	1.5-3.5

Source: Makin and Pratt, 1984

The main problems of the irrigation sector were identified as (*ibid.*):

- surface water scarcity and the high cost of abstracting groundwater;
- inadequate irrigation infrastructure for equitable and efficient conveyance and distribution of the scarce water resources;
- inadequate support infrastructure (access roads, markets, supply of inputs);
- inadequate training in irrigated agriculture; and
- lack of capital for irrigation development.

2.3 Status of existing domestic and livestock water systems

Water supply systems in Makueni District can be categorised as: gazetted water systems (operated by the Ministry of Water Resources), self-help systems, county council systems, individually owned systems and institutional systems serving schools and health centres. There was a general agreement among district staff and farmers that most water supply systems are inefficient and over-strained. The main characteristics of the existing water systems are summarised as follows (see; Kenya, MAP, 1998; Kenya, MoWD, 1998; Kenya, WUAS, 1997; Kenya, MLRRWD, 1994; Makin and Pratt, 1984):

1. Many were constructed over 40 years ago and are reaching the end of their design lives.
2. Most water projects are serving more people than they were originally designed to serve, leading to rapid deterioration of facilities and frequent breakdowns. This creates a service reliability problem, which discourages consumers who may be willing to pay for the services.
3. Poor operational support and inadequate maintenance, resulting from insufficient funds (poor organisational structure for revenue collection) and lack of capacity to operate, maintain and replace ageing equipment.
4. The dispersed nature of water points makes it costly and logistically difficult to monitor the operation of water schemes.
5. High concentration of animals around watering points has resulted in overgrazing, causing environmental degradation, and siltation of pans and dams.
6. There is a high lag time between siltation and de-silting of dams, at high cost.
7. Shallow wells are only feasible in valley bottoms in more humid areas. Where groundwater is available at depths in excess of 30 m, it is not a feasible option for a poor individual or rural local community. Most of the boreholes were dug for government projects, then handed over to County Councils for operation and maintenance, and are now being handed over to the communities.

The socio-economic conditions which are perceived to affect water development include the following (Kenya, MAP, 1998; Kenya, MLRRWD, 1994):

- Poverty levels affect people's ability and willingness to contribute to the development of water infrastructure or to pay for the economic value of water.
- Fetching water is carried out by women and children, who regularly travel long distances to perform this task.
- Most decision makers on water development and management issues are men.
- Fund raising efforts for water development projects are inadequate.

2.4 Increasing cost of water

Water development costs

The cost of rural water supply varies with the type of technology used, the area served, topography of the area, the length of the conveyance and distribution network, source of power, source of water and intended level of service. Kaigai (1996) reported that development cost varies between Ksh 800 *per capita* for a gravity piped system without treatment to Ksh 40,000 *per capita* for pumped systems with treatment.

In the semi-arid area of Makueni, water distribution costs can be very high, due to the dispersed settlement pattern. The average distance from one homestead to the next varies from 300 to 800 m. This implies that provision of piped water to individual homesteads would be very expensive, hence the prevalence of communal watering points or private water supply systems.

Operation and maintenance cost of water facilities

Operations and maintenance costs of water supply infrastructure depend on the type of technology, chemical and energy inputs, volumes of water delivered and operating conditions. The cost of operating and maintaining water supply facilities has increased by over 350 percent since the early 1980s (Annex I). The increase is attributed to changes in world prices of chemical and petroleum products, devaluation of the Kenya shilling and increases in tax on petroleum. Such high operation and maintenance costs means that piped and clean water will remain a dream for many poor farmers unless government subsidies are increased.

Water tariffs

Initial efforts to charge for water began in the late 1950s, when water supply projects were expected to be partly financed by a water rate of Ksh 2.0 *per capita* /yr. (Tiffen *et al*., 1994). This rate was to be part of the African District Council (ADC) rate and was to be used to cover recurrent costs and loan charges on water projects. By 1962 the ADC was experiencing financial difficulties, attributed to the hard times brought about by the drought of 1960 and floods of 1961 and because, during the struggle for independence, the politicians had promised that the independent Kenyan Government would provide free services. After independence in 1963, the water projects managed by the ADC were taken over by Machakos County Council. The water revenue collection was low and services deteriorated to a point where most boreholes ceased to operate (Kyamusoi informant, 1998). Low revenue collection was attributed to low incomes,

recurrent droughts and famine, water stealing, inadequate monitoring, high system water losses, inequitable water deliveries, inefficient revenue collection, lack of revenue collection and enforcement personnel and political pressure.

Government rates for water services have changed over time. In the 1970s the Government introduced a progressive rate aimed at encouraging the efficient use of water resources. This arrangement did not work satisfactorily, owing to a presidential directive in the 1980s that fixed the monthly water charges at Ksh 15.00 per rural water supply connection. The progressive rate was reintroduced in the 1990s. According to Kaigai (1996) water tariffs for rural water supplies are set by the Ministry of Water Development (MoWD) after evaluating requests from private water projects and their affordability. Water tariffs are generally not adjusted to inflation and thus do not reflect the actual costs of water. This was not a problem when there was adequate donor funding for water supply projects. Two rate changes were made in the 1990s (Table 7). The connection fee was set at Ksh 120. The water tariffs have addressed the problem of affordability for the poor rather than cost recovery concerns. Such low water charges serve to protect the poor consumers but also promote inefficient use.

Table 3: Cost of monthly water consumption (Ksh per m^3)

	1995		1997
Water used (m^3)	Urban tariff	Rural tariff	Rural tariff
0-10	90.0 flat rate	90.0 flat rate	120 flat rate
10-30	15	12	15
30-60	20	15	18
60-100	30	20	25
>100	40	30	

Source: Kenya, MoWD, 1995; Kenya, MoWD, 1997.

With declining operation and maintenance budgets for most water projects, the water facilities experienced the following problems:

- Siltation of dams
- Frequent breakdown of borehole pumps
- Delays in the repair of pumps (mainly due to inability of users to pay for water, and the reduced budgetary allocation by central and local government for rural water supplies)

3 COMMUNITY INITIATIVES

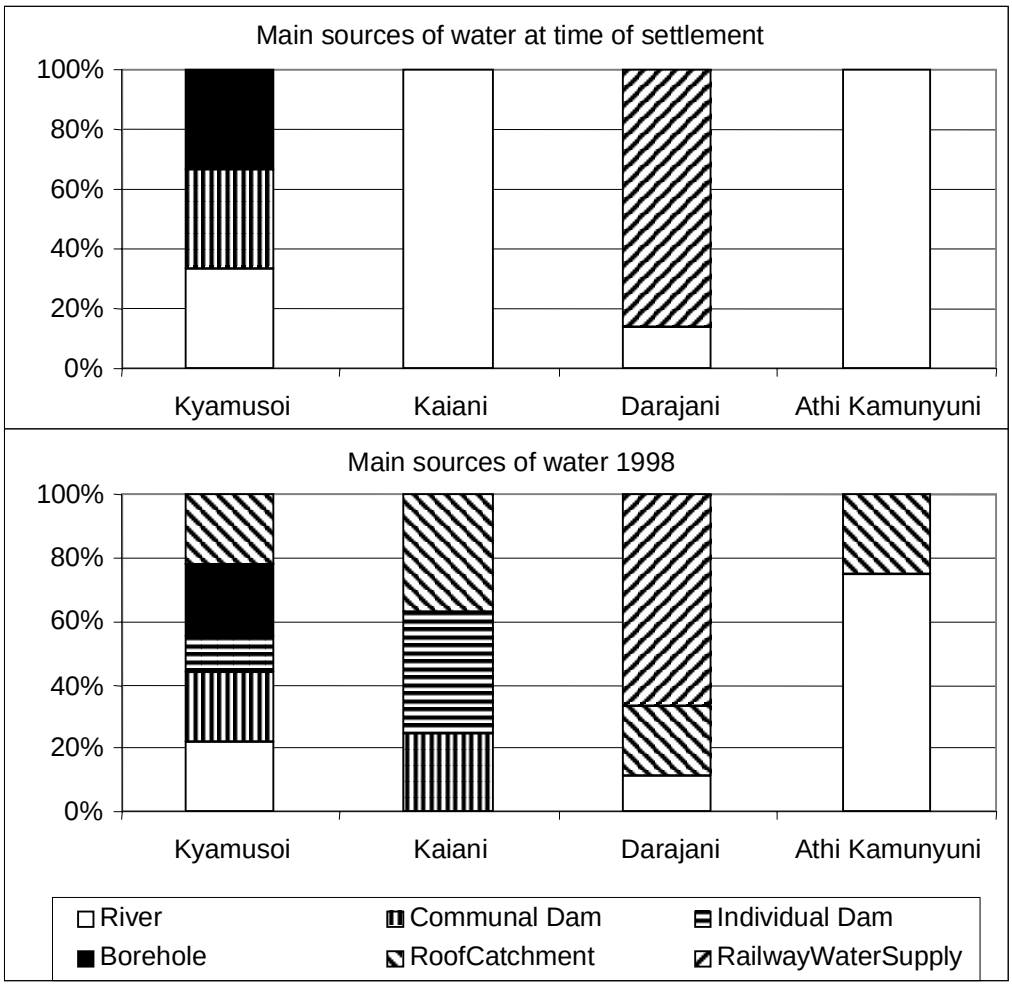
3.1 Relative importance of different water sources

Changes in the relative importance of different water sources was assessed by establishing the main sources of water at the time of settlement and during the study period. The sources of water were identified as rivers, communal dams, private dams,

roof catchments, boreholes and a railway station water supply. The main sources of water at the time of settlement and in 1998 are shown in Figure 2. At the time of settlement, the main sources were the rivers. In all areas, there has been a move towards the development of private water sources. This is attributed to poor performance of the public and community water supply projects (increasing demand, poor maintenance) , decreasing labour availability for fetching water from long distances, availability of technology and donor support.

The importance of the source depends on proximity, the time of the year and cost. At Kyamusoi the main sources of water are the Kaiti river, a dam, a borehole and private roof catchments. The Kaiti River is perennial and 2-3 km away from the respondents' homes. In 1951 the African Land Development Board (ALDEV) water development programme constructed a dam and a borehole. Between 1984 and 1995 the water situation in the area deteriorated as the reservoir was silted and the borehole pump broke down. The river remains the main source of water during the dry season, particularly after the reservoir dries up. It has been the most reliable source of water, as all other sources have had problems at one time or another.

Figure 2: Water sources in four study villages (percentage of respondents)



Source: Questionnaire survey, 1998.

The main source of water for the Kaiani respondents at the time of settlement was the Ikaasu River at distance of 3-5km away from the homesteads. Kaiani respondents have invested in the development of private water sources, partly because of the long distance to a permanent river and the development assistance in dam construction they received. A self-help dam was constructed in 1963-65 in the village, and the Government provided additional assistance for dam construction in 1974, and again in 1994-96. The main sources of water are reported to be streams, a communal dam and individual farm ponds and roof catchments systems.

The main sources of water for the respondents of Darajani are the Darajani railway station, a roof catchment and the Kambu river. The railway station water supply is the main source for the respondents living within 2 km. The sources of water for the respondents of Athi Kamunyuni are the Athi River, seasonal streams and roof catchments. Most of the respondents live more than 5 km from the Athi River.

The relatively long distances to the nearest water source at the time of initial settlement indicates that it was the quality of land and access that influenced the decision to settle rather than the proximity to perennial water sources. However with the growing recognition of the importance of irrigation, the demand for riparian land is increasing.

3.2 Experiences in small earth dams: Kaiani and Athi Kamunyuni

The first dam was constructed in the 1950s as part of the ALDEV programme to supply water to Kathonzweni Township. Since then, many have been constructed. Eighty-three percent of the respondents invested in the construction of their own farm ponds. This is attributed to the long distance to the perennial river and communal dams, no bore holes in the area, large farms with suitable sites, heavy soils with low seepage losses and availability of local expertise in pond construction. Farmers reported that the Government has provided very little support, particularly in the provision of earth moving equipment. The farmers acknowledged the assistance provided through the Machakos Integrated Development Programme (MIDP) and Makueni Smallholder Irrigation Project (MSIP).

Experiences in constructing communal, partnerships and private dams are presented in Appendix II. The main lessons learnt from those experiences are:

1. The area has favourable topographic and soils conditions for small dam construction. Since the farmers have large farms (average farm size of 11.2 hectares) (see Gichuki, 2000a) individual or partnership dams are preferred to reduce the distance to the water source.
2. Farmers have, over the years, gained experience in dam construction skills. The farmers have reduced their reliance on external financial support, as this has resulted in long delays between initial discussion on and actual implementation of externally funded project.
3. Private dams are generally small (<600 m^3 capacity) and their potential for supplemental irrigation not fully tapped.
4. High evaporation loss and low water use efficiency constraints the returns on investments of water infrastructure.
5. The role of community water supply is diminishing, particularly where individual dams are feasible.

3.3 Experiences of local water undertakers

There is good business in fetching and selling water, particularly in Darajani and Athi Kamunyuni areas where there are no communal water projects. The water undertakers use bicycles or donkey carts. Five respondents from Athi Kamunyuni reported that they buy water at a cost of Ksh 15 per 20 litres container (US$12.5 per m^3). Due to the high cost of water, the consumption rate is very low. One respondent reported using five to eight litres per day. Those who cannot afford to pay for water (mainly the mother and school-age children) have to make early morning trips before school.

3.4 Roof catchment experiences

Investments in roof catchment water harvesting vary from corrugated iron roofs with full or partial gutters to thatched roofs with partial gutters. Water storage tanks vary from masonry water tanks to used oil drums. Some respondents have made impressive investments in water harvesting and storage. Mr. John Muasya of Kaiani village (a school teacher) has constructed two masonry water tanks with a total storage capacity of 6 m^3. Mr. Kavivya Kaminza of Athi Kamunyuni has a corrugated iron roof catchment of approximately 24 m^2, 5 m of guttering and a water tank of 5 m^3 capacity water tank constructed in 1996. This caters for his domestic water requirements, except for prolonged dry spells lasting more than four months.

The potential for alleviating water constraints through roof catchment water harvesting systems has not been fully tapped. This is attributed to the high cost of water storage and small roof catchments.

3.5 Irrigation experiences

Supplemental irrigation for vegetables and fruit trees is practised by 30 percent of the respondents, most of whom live within 2-3 km of rivers. The largest number was in Kaiani area, due to its proximity to Kathonzweni market and to the water storage facilities developed by the inhabitants. Experiences of the farmers visited and those documented by the irrigation engineer are presented in Appendix III. Experiences in irrigated agriculture (Kamami, 1998) show that:

1. Irrigation development is constrained by availability of water and investment capital. Low cost, efficient irrigation methods should be used.
2. Developing group-based irrigation projects in ASAL is not easy as farmers are not used to taking loans.
3. Investment in irrigation development cannot be optimised without adequate infrastructural support (markets, roads, inputs, etc).
4. With the right conditions, irrigation is profitable and can create more jobs.
5. Water harvesting for crop production has been introduced, but is not catching on as fast as in the sub-humid areas, due to the large size of farms and extensive farming.

3.6 Community managed domestic and livestock water projects

The Government has started the process of handing over some of the gazetted rural water supply systems to farmers (see above). The case of Kyamunyolo borehole and dam rehabilitation illustrates the changes that have taken place and communities'

willingness to invest more to improve their water situation. By 1985, the Machakos County Council was unable to maintain the pump and the system was inoperational until 1995. The borehole was then rehabilitated and handed over to the community water users' association. The membership fee was set at Ksh 100.00 (1.3 US$) and the water charges were fixed at one shilling for a 20-litre container (US$0.83 per m^3) for domestic use, and one shilling per cow/bull or two shoats. A similar fee structure was used for the rehabilitation of the dam in 1997, which had silted up in the 1970s.

Water fees for community based water projects vary from project to project. Table 4 presents rates charged by different projects.

Table 4: Water charges for community-based projects

Water project	Rate
Kyamunyolo dam	Ksh 0.5 per 20 litres
Kilili Mwau dam	Ksh 3 for members and Ksh 5 for non-members for 20 litres for communal watering point Ksh 25/m^3 for members for individual connection
Mulima water supply	Unmetered individual connection Ksh 90 per month Metered institutional connection Ksh 25 per m^3
Kilala scheme	Unmetered communal water point 50 Ksh/month
Athi Kamunyuni	Ksh 15 / 20 litres
Private water undertakers	

Source: Questionnaire survey, 1999; Kenya, WUAS, 1997.

4 EXTERNAL INTERVENTION

4.1 Policy statements and strategies

Political support

The political support for water resources management is exemplified by the President's commitment to conservation of natural resources:

> His Excellency the President, Daniel T. Arap Moi, has shown the way and constantly impressed upon the Kenyans the importance of environmental conservation and in particular the conservation and rational utilisation of the nation's water resources. He has on many public addresses to the Nation warned that the indiscriminate felling of trees and destruction of natural forests, the removal of ground cover and overgrazing of marginal lands, all lead to one result: soil erosion and decreased river flow. (Kenya, PPCSCA, 1988: 19)

National campaigns on the conservation of natural resources, spearheaded by the President in the 1980s, generated public awareness and appreciation of the importance of natural resource conservation.

The current initiative reviewing the Water Act addresses the weaknesses brought about by changes in resource availability, increasing demand for water and the associated conflict over water use.

4.2 Water policy and strategy changes

Water issues and policy responses

Policy changes are driven by changes in resource availability, use, conservation and the need to resolve existing or potential conflicts. The issues that have resulted in policy changes are summarised in Tables 5 and 6.

Table 5: Water issue and related policy and strategy response, 1940s-1970s

Decade	Issue	Policy and/or strategic response	Impact
1940s	Water is identified as a major constraint for human settlement in semi-arid areas.	Funds are provided for dam and borehole construction under Colonial Development and Welfare Fund and ALDEV.	Adequate domestic and livestock water is supplied to Makueni Settlement Scheme.
1950s	Concerns are raised about how to finance operation and maintenance cost of water projects	A water rate of Ksh 2 *per capita per annum* is introduced as part of the African District Council rate.	
1960s	Non-payment of water rates is blamed on 1960/61 drought and famine, and political reasons following independence.		African District Councils experience serious financial difficulties.
1970s	Concerns are voiced over water scarcity and the long distances that people walk to fetch water.	A Water Department is formed in the Ministry of Agriculture in 1970 and a full-fledged Ministry of Water Development established in 1974. Government commits itself to the provision of "water for all by the year 2000".	Local contributions to water resources development diminish. Donors provide funds for capacity building and development of water projects.

Table 6: Water issue and related policy and strategy response, 1980s-1990s

Decade	Issue	Policy and/or strategic response	Impact
1980s	Ministry of Water Resources bureaucracy is viewed as a constraint to faster development of water supply projects.	National Water Conservation and Pipeline Corporation, a parastatal, is established to develop water supplies and serve as a water undertaker.	Major water projects are implemented (none in Makueni District).
	The President sympathises with the rural poor over the high water charges.	The Ministry of Water Development is directed to charge a flat rate of Ksh 15 for all rural water consumers.	County council water revenue declines as the cost of operation and maintenance increases and hence some water projects are abandoned.
1990s	Government and donor funding is unable to keep pace with the demand for development capital.	A cost sharing policy in water resources development is adopted.	In 1995/6 Makueni District collects over Ksh 1 million in irrigation water fees in three months. The initiative does not get support and hence is discontinued. The funds are to be used in the district to finance water resources development projects.
	The Ministry is unable to manage small water projects.	Government decides to devolve water supplies to community level.	
	There is a lack of suitable sites for large water projects and a lack of funds for implementing such projects.	There is a shift from large water supply projects to small water supply projects.	

National water policy

The national water policy is currently under review (Kenya, 1999). The review involves a re-evaluation of the role of the key actors in the water sector with a view to proposing new and appropriate roles that are in line with the needs of the sector. The role of the Government in the water sector is being redefined, with an emphasis on regulatory and enabling functions as opposed to direct service provision (Annex IV).

Irrigation policies and strategy changes

The main goal of smallholder irrigation policy is to contribute to alleviating poverty by increasing agricultural production, creating jobs and earning foreign exchange through the export of irrigated horticultural produce. Changes that have taken place in smallholder irrigation guidelines, strategies and policies are summarised in Table 7.

Table 7: Irrigation guidelines, strategies and policy changes

Period	Issue
Pre1970	New irrigation projects are developed to assist nomad/semi-nomadic pastoralists to settle.
1970s	Irrigation and Drainage Branch is established in 1978 to facilitate the development of smallholder irrigation projects.
1980s	Capacity building and rehabilitation of group based irrigation projects are undertaken with grants provided by donors. A cost sharing approach is promoted.
1991	A smallholder group-based drainage development project is incorporated.
1993	Cost recovery in irrigation development is introduced and season input credit is provided.
1994	There is a move toward loan programme. Funding smallholder irrigation projects on a grant basis is phased out and replaced with a cost recovery system. Grants are only applicable for irrigation projects with poor access to horticultural markets, and hence mainly producing food crops or for very poor communities.

Source: IDB, 1991; District informant, 1998.

The introduction of a cost recovery strategy and the move from grant financing to loan financing of irrigation infrastructure development was perceived as a donor-driven change. The change took place in a very short time and therefore did not give people an opportunity to fully assess the positive and negative impacts. Consequently, irrigation farmers who had been anticipating grant financing for the rehabilitation of their schemes resisted the loan programme strategy.

4.3 Institutional and legal framework

There is a strong vertical integration of government institutions, starting with the Minister of Water Resources and extending to the field officers based in divisions and in some locations. This system, however, is based on a top-down approach and does not facilitate integration of local issues into national policy. It does not foster efficient inter-ministerial collaboration. There is also some duplication of services, resulting from overlapping mandates and functions. Water and Agriculture ministries have overlapping programmes in catchment protection, river bank conservation, water use and water development (e.g. the soil and water conservation branch of MoALDM and Ministry of Water Resources are both promoting small earth dams).

Legislation on water resources has had little impact in dealing with water offences such as unauthorised water abstraction and water pollution. The main factors inhibiting enforcement of water legislation are (District Water Office informant, 1999):

- a lack of awareness of the negative impact on the downstream water users who may be several kilometres away;
- inadequate policing;
- low fines for offenders; and
- a lack of incentives to minimise water pollution and facilitate efficient use of water resources.

4.4 Government and donor programmes

Gazetted water supplies

The water operations and maintenance section of the Ministry of Water Resources operates gazetted water supplies. In Wote and Kikumbulyu, operation and maintenance costs are higher than the revenue collected (Table 8). The Government therefore continues to subsidise water users.

Table 8: Expenditure and revenue for gazetted water supplies in AEZ 5&6 in 1997

Scheme	Expenditure	Revenue collected
Wote Urban	1,105,962	264,357
Makindu Urban	779,512	833,727
Mtito Andei Urban	802,781	975,285
Kikumbulyu Rural	2,202,115	1,355,731

Source: MoWD, 1998.

Implementing and cost sharing policy

Water scarcity has been identified as the main constraint to development in the semi-arid areas. Consequently, donors have allocated substantial amounts of money. The current Makueni Agricultural Programme (MAP) budget allocated 22 percent to soil and water conservation and a further 22 percent to water supply. Cost sharing is a strategy used to encourage community members to participate more actively in the projects they consider beneficial and worth investing their time and money in. A total of 373 dams were constructed in Makueni District between 1994 and 1998, to serve 15 to 200 beneficiaries each. Cost sharing guidelines are presented in Appendix VI.

This cost sharing strategy has proved effective in resolving ownership issues, as small water supply projects developed by the Government were generally perceived to be owned by the Government, and hence the communities do not actively participate in their operation and maintenance (District Informant, 1998).

Implementing community participation in water management policy

One of the major changes in the National Water Policy is the privatisation of water supply systems. In the rural area this was to be achieved by handing over of water supplies to local communities and creating an enabling environment for their full participation. Water Users' Association Support Project (WUAS) was initiated in 1994 (MLRRWD, 1994) with the aim of building capacity in community management of water projects. The core activities were to increase the capacity of government officers to regulate, advise and supervise water users associations, to establish efficient and more effective community-based water organisations, to rehabilitate water supply facilities (thereby improving access to water), to promote private sector involvement in water supplies, to provide credit facilities for development of water supplies, to promote hygiene and sanitation and to promote community efforts in watershed protection. Makueni District was one of its pilot districts. The project provides training and supervision support, while the community provides the tools and pays the dam supervisor. The profiles of some of the dams are presented in Appendix 7.

The problems experienced include siltation, leaks, vandalism, non-payments, lack of financial management and accountability, and unclear division of duties and responsibilities. The WUAS project has been involved in solving these problems since 1997.

Irrigation development

Smallholder Irrigation Development Programme: The Irrigation and Drainage Branch of the Ministry of Agriculture, Livestock Development and Marketing is charged with the responsibility of developing guidelines, strategies and policies for smallholder irrigation development. The branch was established in 1978. During its early years the emphasis was on capacity building for engineers and irrigation officers. The donor-assisted Smallholder Irrigation Development Programme (SIDP) (1978-1994) provided grants for the development of new irrigation projects and rehabilitation of existing projects. The programme supported a District Irrigation Unit, the rehabilitation of four irrigation projects in AEZ 3&4, six irrigation projects in AEZ 5&6; and a study on smallholder irrigation development and options for financing infrastructure and seasonal input costs (IDB, 1993).

The donor-funded Makueni Irrigation Support Programme (MISP) was started in 1993. The programme goal was to assist the farmers through the improved use of the physical resource base, in the form of more cultivation, better irrigation methods, diversification of crops and improved water availability, establishing a revolving fund used as security for loans for purchase of farm inputs, enhancing crop, horticulture and irrigation extension, enhancing soil and water conservation activities through support of community mobilisation, agro-forestry promotion and soil fertility improvements, training in home economics, nutrition improvements, small-scale income generation projects and family planning, training in marketing and provision of market information and developing decision support information on major crops and farm planning.

Irrigation credit scheme

In 1990 the IDB started exploring options for accelerating the pace of smallholder irrigation development. A cost-recovery strategy was proposed for irrigation

infrastructure development and for financing seasonal production inputs. In 1991, the Smallholder Irrigation Support Development Organisation (SISDO), a non-profit non-governmental organisation, was established with local banks to provide loans for the development of infrastructure for group-based, gravity-fed irrigation projects, individual pump-fed irrigation projects and seasonal credit for production inputs (IDB, 1991).

The first beneficiary was the Mwethya-Muveleki irrigation project, at Kibwezi. The scheme is in an area that frequently receives famine relief. The main problem experienced by irrigators was the unreliability of the water supply system. The funds were therefore used to rehabilitate the water supply and distribution system. Loan repayment has been constrained by the following factors (IDB, 1995):

- a lack of a common understanding of the group guarantee concept at scheme, group and household levels;
- weak farmers' organisation, leading to inequitable distribution of water and poor marketing strategies;
- farmers' reluctance to repay the loan in the hope that it will be waived[1]; and
- low profitability, attributed to low production levels(low level of inputs and poor crop and water management) and low farm-gate prices (exploitation by middle men)

The credit scheme has worked successfully in the provision of seasonal credit for inputs (seeds, fertiliser and pesticides) required for intensifying irrigated agriculture (Kamami, 1998, personal communication).

CONCLUSIONS

Water is considered to be very scarce in the semi-arid areas except along perennial rivers. There is also a high spatial and temporal variability in-river water resources, and the ephemeral rivers carry high flows during the rainy seasons and are completely dry during the dry seasons. Water scarcity is therefore a recurring phenomenon.

The main sources of water supply in the semi-arid areas are rivers, communal dams, roof catchments, private dams, and boreholes. Since settlement, rivers have diminished in importance relative to communal water sources (dams, boreholes and gravity-fed water supply seasons) and more recently to private water sources (individual farm ponds and roof catchments), reflecting increased investments.

The adequacy, equity and reliability of government rural water supply projects have deteriorated. Due to inadequate budgetary provision, facilities have not been upgraded to cope with increasing demand, and technical performance has declined with increasing age of equipment and inadequate maintenance.

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[1] This problem was exacerbated by the contradiction between SISDO (the implementing organisation) policy and MISP (the funding institution) policy. MISP was keen to provide subsidies since this is a famine relief area.

Individuals and communities have had to invest more, participate in decision-making and provide labour for water development to cope with the increasing demand from human and livestock populations and increased consumption *per capita*. In the process the community has gained water management experience in communal, partnership and private dams, water supply businesses, and roof catchment and storage systems.

Government policy on domestic and livestock water supply has evolved from provision of free services to cost-sharing. Users of water supply are required to pay fees for services and become more actively involved in the implementation, operation and maintenance of the utilities. The Ministry of Water Resources is therefore gradually devolving actual management to the users and retaining only policy formulation, regulation and facilitating roles. Water users are being involved more and more in making decisions on water tariffs, modes of payment and the level of service required. Devolution of government services and the introduction of cost-sharing policies have resulted in reduced reliance on the Government, as evidenced by increasing public acceptance of the necessity to pay for services and growing appreciation that commercial principles in management are necessary to obtain reliable services.

Most of the irrigation potential in semi-arid areas (Wote, Kathonzweni, Makindu, Kibwezi and Mtito Andei Divisions) remains relatively untapped. Constraints on the success of irrigated agriculture include: (a) market factors such as poor access, low or fluctuating prices, exploitation by middlemen and competition; (b) low level of capital investment due to poor access to credit, low income, and high transaction cost of lending institutions; and (c) inefficiency in irrigation practices and underdeveloped water storage. These constraints lower the profitability of smallholder irrigated agriculture, leading to vicious circle of lower profitability and lower investment.

Investments in water management have therefore been made to meet domestic and livestock water needs, for supplemental irrigation of kitchen gardens and fruit trees, and where runoff concentrates (cut-off drains, *fanya juu* terraces and banana pits). The potential for water harvesting roadside runoff has not been fully tapped.

Investments have increased over time in response to increasing demand and notwithstanding the high cost of water development. Farmers' investments have increased relative to external investment, which has decreased.

Unlike investments in soil conservation which can be spread over time, water development requires a high one-time investment (e.g. constructing a farm pond or buying a pump). Public investment has been cyclic, with construction and rehabilitation phases, rather than continuous to cater for operation and maintenance. This cyclic investment is now being replaced by more continuous investment under community management, where water fees cover the total cost of operation and maintenance.

While the policy changes have lagged behind those changes needed they have addressed major concerns. The constraint has been in translating these policies into joint action

plans between farmers and the Government. There is need for better targeting of policies and programmes to create a conducive environment[2]:

ANNEX I

Chemical, energy and maintenance cost of rural water supplies

A national study on operation and maintenance costs of rural water supply analysed chemical, energy and maintenance costs of equipment (see table below), excluding staff costs (Kaigai, 1996). It also reported that the treatment cost rose from Ksh 3.5 per m^3 of water treated in 1980's, to Ksh 8.5 per m^3 water treated in 1996. The cost of diesel has increased from Ksh 10.0 per litre to Ksh 35.0 per litre during the same time period.

Table A1: Chemical, energy and maintenance costs of rural water supplies

Energy source	Without treatment	With treatment
Gravity	4.0-6.0	5.0-7.5
Electric pump	9.0-5.0	12.5-20.0
Diesel pump	21.5-36.5	19.5-55.0

Source: Kaigai, 1996.

ANNEX II

Experiences in small earth dam constructions

The Communal dam: In 1965, the Kaiani community decided to construct a communal dam. The construction work was started by 15 people. Each volunteered to excavate a core trench section (8 m x 1 m x 1 m) and to provide sand for the initial sand bag barriers. The dam's construction was carried out step-by-step over a period of 15 years. At the end of each dry season, the members would participate in the de-silting and increasing the height of the dam embankment. Non-members were required to contribute to the construction of the embankment by adding approximately 1 m^3 (five wheel barrows) of soil each time they came to draw water. By 1982, the dam had attained an embankment height of 6 m and a length of 110 m, and had a total of 34 members. In 1996, the community was promised assistance in improving the water abstraction facilities. The water abstraction facilities to be constructed would consist of

[2] Introducing a graduate water tariff for irrigators and providing targeted subsidies (for the poor and for investors in high cost water development projects such as dam construction and borehole drilling) would serve this end.

a well and a hand pump located at the downstream end[3]. The members were to construct a 10 m deep well on the lower side of the dam, while the DANIDA funded MSIP project was to provide well casing, a pump and technical expertise. By the time of our visit the farmers had constructed the well but the promised external assistance had not been received. The members have given up waiting for external assistance and plan to complete the project through *harambee* (self help) contributions.

Partnership dams: The potential of partnership dams exists where two farms have a natural waterway as their boundary. Two examples of such co-operation are presented here:

1. Two farmers Mr. X and Mr. Y have a common waterway that forms the boundary of their farms. Being good neighbours they decided to construct a partnership dam across the natural waterway in 1985. Both were respected members of the community and distant relatives.[4] They constructed a dam with an embankment 2 m high and 20 m wide with a storage capacity of approximately 400 m^3. They were to use the water for supplemental irrigation and livestock use. Their original agreements was that: (1) they would share the construction cost; (2) they would irrigate roughly equal parcels of land; and (3) they would fence the reservoir area to keep off livestock. Problems started in 1987 as a result of difference in water use and managers.[5] Mr. X unilaterally resolved the problem by erecting a sandbag barrier dividing the reservoir longitudinally. Mr. X increased the storage capacity of his side of the dam by excavating to a depth of 5 m. He earns 10-20,000 shillings per season by irrigating vegetables, whereas Mrs. Y mainly uses her half of the dam for livestock watering.

2. Mr. A is a school teacher and a neighbour of Mr. B. In 1986, Mr. A and Mr. B decided to adopt the partnership model of constructing a dam across a common waterway. Their verbal agreement was that they would make equal contributions towards the construction and maintenance labour, and irrigate equal parcels of land. The dam was constructed using family labour over a period of two years. Due to the high silt load, they desilt the dam every year. The material they de-silt is considered to be fertile soil, and is spread in their irrigated plots. Mr. A is the main beneficially of this partnership dam. In 1996, Mr. A planted 1000 m^2 of tomatoes and sold them for over 20,000 Ksh. This has not strained their relationship as they believe that with time their contributions and benefits will even out. In November 1997 the dam was filled with silt and part of the embankment destroyed by the high runoff. During the time of our visit, they were de-silting the dam and repairing the embankment.

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[3] A well located at the downstream end of the dam was preferred as it would lead to improved water quality and water availability, particularly during the dry season when the surface reservoir dries up.

[4] Mr. X worked for the Post-office and Mr. Y was a successful businessman. Mr. Y's grandmother was Mr. X's aunt.

[5] Mr. Y died in 1986, and Mr. X retired and concentrated on farming activities. Mrs Y did not respect the verbal agreements, and started watering her animals directly from the dam, thereby polluting the water and increasing siltation.

Private dams: Private farm pond construction began in 1984 with one of the farmers deciding to take advantage of the large volumes of water that flow in the seasonal stream across his farm. The notable experiences observed are presented here.

1. Mr. C settled in his farm in 1985, and constructed his first farm pond in 1988. The pond was located at the eye of an old spring, which was one of the sources of water for the original settlers. The sources of water are the spring, supplemented by runoff harvested from the homestead and the road catchments. With a capacity of 380 m^3, this reservoir is used to irrigate a vegetable plot of approximately 1000 m^2. In 1996, he grew kale and tomatoes, which he sold for 6,000 Ksh.

2. Mrs D's farm is 4 km away from Matinga dam, the main source of water for Kathonzweni town and three kilometres from Kaiani communal dam. She therefore invested in her own on-farm ponds. The first pond was constructed in 1982 and measured approximately 20 m x 6 m x 2 m. The pond was abandoned in 1991 as the salinity built up to an unacceptable level. A second pond, measuring approximately 12 m x 3 m x 2 m, was constructed in 1992. This dam is mainly used as a source of domestic water, and for supplemental irrigation. During the time of our visit, the dam was the source of water for a 36 m^2 irrigated vegetable plot.

3. Mr. E of Athi Kamunyuni, constructed a farm pond (approximately 400 m^3 capacity with a mean depth of 1 m) in 1996. There is no natural waterway and hence the pond was constructed at the lower end of his farm to store runoff mainly from the food paths, roads and homestead catchment areas. Consequently high levels of siltation occur. The pond dries up 10-20 days after the rains due to the high evaporation and seepage losses. The water is mainly used for supplemental irrigation of tree seedlings.

4. Mr. F of Athi Kamunyuni is fortunate to have a perennial stream flowing across his farm. In 1997 he constructed a diversion weir, using 25 sand bags to divert water for irrigation. During the time of our visit he was irrigating spinach and okra (400 m^2 plot), using the bucket method. There were, however, signs of salinity problems.

ANNEX III

Experiences in smallholder irrigation

This section documents irrigation experiences reported by the irrigation engineer (Kamami, 1998).

Marketing constraints: Farmers of Kavingoni Location reported that with the help of supplemental irrigation, they were able to grow vegetables for home consumption and for sale (Kenya, MAP, 1998). However, marketing of their produce is constrained by the distance to the market, exploitation by middlemen and competition with rainfed-vegetables from neighbouring sub-humid areas.

Riparian farmers not irrigating: One respondent has a farm with frontage on the Kambu river. His main source of domestic and livestock water is therefore the river. Ironically,

although there were neighbouring farmers that were irrigating, he had not considered investing in irrigation. The reasons given were high costs, exploitation by middlemen and inadequate family labour.

Individual investment and market constraints: Mr X's farm in Kikome village, Kitise, is located is located 10 km form Kitise market. He bought the farm in 1992 and started irrigating in 1993. He irrigates five acres using pumped water from the Athi River. The project is self-financed. He grows citrus, mangoes, paw paws, bananas, kale, cabbage and tomatoes. He sells his produce at the farm and fetches half the market price at Wote market (Kamami, 1998).

Benefits of irrigation for groups: Wooni wa Kikome group was formed in April 1998 and has 10 members. The objective of the group is to lease one acre of land and start irrigated agriculture. Only the chairman of the group has riparian land and irrigation experience. Their desire to get into irrigated agriculture is driven by optimism over the profitability of irrigated agriculture (Kamami, 1998).

*Donor assisted project***:** Mutethya irrigation group was started in 1996 and is registered with the Ministry of Culture and Social Services. The group has four men and 26 women. Initial group investment consisted of a membership fee of Ksh 15 and labour for clearing and setting up the irrigation project. They were given land by one of the members and the NGO German Agro Action (GAA) assisted them in constructing a water storage tank and paid for half the cost of the pump and pipeline. GAA also provided them with tools. The farmers grew tomatoes, kale and cabbages on small individual plots. The project is currently not operating, due to disputes between the farm owner and the members.

Problems of getting loans: Mr. G owns riparian land along Athi river that he bought in 1984. The farm is 25 acres, of which 14 are under rainfed agriculture and five are irrigated. The irrigation fields are part of the high flood plain of the river. Water is pumped from the river and conveyed through PVC pipes to the irrigation fields. He grows kale, chillies, onions, eggplants, carrots and citrus fruits. He sells his produce locally or to a buyer in Nairobi. He has been looking for a loan of Ksh 400,000 to extend his irrigated area with no success, as the financing institutions either have no money to lend or he does not meet their requirements (Kamami, 1998).

Problems of loan repayment: Ngenda Matheani Women's group irrigation plot is located 4 km from Matheani market. 30 members started the group in 1993 but its current membership is 14. The group has a tree nursery and irrigates a quarter of an acre of tomatoes, cabbages and chillies. They have received watering cans and rakes from the MISP project and education seminars by World Vision. World Vision also provided them with a pump and accessories on loan (Kamami, 1998). The pump has not been put to use as the farmers continue to use bucket irrigation. The farmers are unable to repay the pump loan, due to their low level of operation (0.25 acres for 14 farmers).

Successful expansion: Mr M works for an NGO at Kathonzweni. He was allocated land by his sister at Yekanga Sublocation of Kanthuni Location. In 1994 he started irrigating and in 1995 bought a second-hand pump, using the proceeds from the sale of irrigated crops in 1994 (Kamami, 1998). He later constructed a water storage tank. He grows cabbages, onions, kale, tomatoes, paw paws and bananas. He has employed two

permanent workers and engages several casual labourers. He has bought his own farm and plans to transfer the irrigation infrastructure to the new farm, and increase the irrigated area. He has accomplished all this with his farming experience and limited extension assistance.

ANNEX IV

National water policy

National water policy is articulated in many policy statements addressing:

- water resources management (the protection of available water resources and their sustainable, rational and economical use);
- water supply and sewerage development (to 'supply water of good quality and in sufficient quantities to meet the various water needs, while ensuring safe disposal of wastewater and environmental protection');
- institutional arrangements (establishing an efficient and effective institutional framework to achieve the systematic development and management of the water sector);
- financing of the water sector (developing a sound and sustainable financing system for effective water resources management, water supply and sanitation development);

The main policy statements relevant to the semi-arid areas of Makueni are as follows:

1. *Decentralisation of decision making* (national, basin, sub-basin and catchment)
2. *Strengthening the enforcement of the Water Act* and harmonising other relevant Acts of Parliament. An integrated water resources management approach is proposed, based on 'the perception that water is an integral part of the ecosystem, a natural resource, a social and economic good, whose quantity and quality determines the nature of its utilisation' (Kenya, MoWR, 1998: 13).
3. *Use of a multi-objective approach*, incorporating environmental impact statements to minimise negative upstream and downstream environmental impacts
4. *Establishment of comprehensive water resources databases*
5. *Creating an enabling environment* for active participation of beneficiaries in the development and operation of water supplies, in line with government policy of cost sharing (Kenya, MoWR, 1998)
6. *Mobilising local and donor resources*
7. *Application of the 'user pays' principle* That is, water will be considered as an economic good and the abstractor charged a fee commensurate with the amount of water abstracted.

ANNEX V

Institutional and legal framework of water resources development

The key government players in the water sector are the Ministry of Water Resources (formerly Ministry of Water Development), the Ministry of Culture and Social Services and the Ministry of Agriculture, Livestock Development and Marketing. The Ministry of Water Resources is charged with the responsibilities of protecting and developing water resources. Its main activities are in water resources assessment, water resources development and water resources regulation. The Ministry of Cultural and Social Services plays a key role in water management through community mobilisation, training water users association members and ensuring that water users association bylaws are enforced. The Ministry of Agriculture, Livestock Development and Marketing's role in the water sector is in the conservation of soil and water resources and the development of smallholder irrigation projects.

The organisational framework within the Ministry of Water Resources includes: the National Water Board, responsible for issuing all water authorisations and permits; the Basin Water Boards, which considers the applications for water exploitation for each catchment and recommends them to the National Water Board; the District Water Boards, which manage water at district level in accordance with the District Focus for Rural Development; the Regional Development Authorities, established to plan for the utilisation of resources in each particular catchment basin; the National Water Conservation and Pipeline Corporation established with the objective of improving efficiency of water projects developed by the Government; and the District Water Engineers, responsible for the overall planning, control, and management of all water related matter in the district.

The Water Act (cap. 372) of the Laws of Kenya, defines the legal framework for the management of the water resources. It is complemented by the Public Health Act, (cap 242), Agricultural Act, (cap. 318), The Local Government Act (chapter 265) and the National Water Conservation and Pipeline Corporation Order, 1988 (Hukka, 1996).

ANNEX VI

Water sector cost sharing guidelines

1. Crawler made dams: 10 percent of the excavation cost for dams less than 5000 m^3, 15 percent for dams 5000-1000 m^3 and 20 percent for dams more than 10000 m^3 capacity.
2. De-silting of dams: Labour for soil and water conservation in the catchment area.
3. Sand dams and rock catchments: site, 15 percent of construction cost, wages for artisans, locally available material and labour for conservation measures in the catchment area
4. Small dams: site, dam supervisor's wages, locally available material and excavation.
5. Shallow wells: site, locally available material, artisans' wages and Ksh 15,000 for a hand pump.

ANNEX VII

Profile of communal dams

- Kiumoni dam was constructed in 1997. It has an embankment height of 1.5 m, a length of 50 m, a throwback of 100 m and a storage capacity of 750 m^3. The dam users association has 47 members and serves water to approximately 235 people.
- Kilala gravity water scheme was initially implemented by the Catholic Diocese of Machakos in 1984, with the community contributing manual labour and finances. In 1996, the project constraints were identified as catchment degradation causing siltation/pipe blockage during the rains, and inadequate water as a result of over abstraction. WUAS has assisted in rehabilitating the project and in training the community. The members paid a membership fee of Ksh 650 and a monthly contribution of Ksh 50 for getting water from communal water points.
- Mulima Water Supply Project is a self-help project initiated by MIDP in the 1980s. Construction was completed in 1988, and in 1989 the project was handed over to the community. The project covers seven sublocations, and supplies water to 35,000 people through 958 registered and unmetered individual connections, and 63 institutions. The project employs eight people. The water fee is Ksh 90 per month for individual connections, and the institution rates depend on the volume of water consumed. Although there are many defaulters, the monthly revenue was estimated at Ksh 65,750 in 1997.

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