Where there is no water

a story of
community water development and
sand dams in Kitui District, Kenya

SASOL
and
MAJI NA UFANISI

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1999

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Acronyms

ASAL	Arid and semi-arid land
CBO	Community based organisation
DANIDA	Danish International Development Agency
DFID	Department for International Development (UK)
ICAC	Internationol Christelijk Steunfonds, Netherlands
ICS	International Christian Aid, Canada
MNU	Maji na Ufanisi (Water and Development)
NGO	Non-government organisation
PRA	Participatory Rural Appraisal
SASOL	Sahelian Solutions Foundation
SIDA	Swedish International Development Authority

For I will provide water in the wilderness
and rivers in the barren desert. Isaiah 43:20

Foreword

The story of the Kitui sand dams is important for all arid and semi-arid lands (ASALs). It is especially so since the population densities are increasing. It is now estimated that 35-40% of all Kenyans live in the ASALs. These are the same areas that in the past were denied development resources because the returns on investment would be better in the high-potential areas!

There would not be a sand dam story if the women of the project area did not play their usual key role of doing the bulk of the development work in the district. During construction of the dams on the Kiindu River, they formed more than 80% of the workers. The bulk of the men are working outside the district. We honour the partners we work with in Kitui and it is our hope that we in SASOL merit their trust.

Also, there would not be a story if there had not been a Mukusya and Utooni Development Programme. Mukusya and Utooni showed the way. They trained the first partner community groups on sand dams They gave us technical advice while others quibbled about technical specifications.

SASOL's objective is to build sand dams in all rivers in a 200 km^2 part of Kitui District. This area was selected first because it would lead to serving a very large number of people. It also has diversity of soil and river morphology, enabling SASOL to evaluate different construction and management practices. The area encompasses old settlements and new settlements. This leads to diversity in organizing development. Lessons gleaned here will be useful elsewhere.

On behalf of Kitui partners, we would like to thank Jon Lane, who took a chance with us when he was new at WaterAid. SIMAVI has always graciously funded SASOL's schools programme, and we thank it. Over the last year, DFID and Sida have begun to fund us. We welcome their help. Finally, this write up is part of an external evaluation based primarily on one river – the Kiindu and its tributaries. We need help to continue with the work on other rivers. As time goes by, we shall report on changes in the physical and social environments in greater detail.

G-C. M. Mutiso
on behalf of the SASOL Board

Chapter 1
Targeting water

Kitui is a town of about 15,000 inhabitants set in the rolling plains of Kenya's Eastern Province, three hours by road from the capital, Nairobi (fig. 1 1). The town is the administrative centre for Kitui District, and being at a higher elevation than most of the surrounding area, it has slightly better rainfall and a more favourable climate. But much of the district is semi-arid, and lack of water is a perennial problem. On the outskirts of the town is a small office from which Sam Mutiso, SASOL's field director, co-ordinates and manages a pioneering programme of community action to tackle the problems of water.

Kitui District[1] extends for roughly 200 km from north to south and 120 km from east to west. SASOL focuses on an area of about 200 km^2 in the central division because it has the largest population – more than 150,000 Akamba people according to the 1989 census, and a population density of about 120 persons per square kilometre. This means that there are more people who will benefit from improved water supplies and more people available to carry out development than in the more arid but thinly populated areas. Put another way, providing water means serving many people.

Although Kitui town has an average rainfall of about 1,000 mm a year, such figures mean very little as there are wide fluctuations from year to year. Rainfall is normally concentrated in two short seasons, November-December and March-April, the former being more reliable for growing maize than the latter[2], but it is common for rains to fail in one or both seasons and for long periods of drought and food shortage to occur (box 1.1). Local lore states that rains fail completely at least one year in four.

Southward from Kitui town at 1,100 m above sea level, the elevation falls gradually, rainfall decreases and the land is characterized by scattered homesteads and irregular patches of cropland interspersed with areas under grass or bush. Indigenous trees such as *Acacia tortilis* and *Terminalia brownei* are common, and together with the occasional baobab, typify the hot, dry conditions that prevail. *Senna siamea* trees with bright yellow flowers are noticeable around many homesteads, and sisal together with the shrub *Lantana camara* is common along field boundaries. What was formerly

[1] The former Kitui District was subdivided in 1994 to create two districts, Mwingi in the north and a smaller Kitui in the south. The figures given here relate to this new Kitui District.

[2] In the project area, the March–April season has a 60% probability of getting between 200 and 250 mm rain whereas the November–December season has a 60% probability of getting between 350 and 400 mm

Box 1.1 History of drought and famine in Kitui District

1868	drought and famine known as *Yua ya Ngovo*
1870	drought and famine known as *Yua ya Ngeetele*
1878	prolonged drought and famine known as *Yua ya Kiasa*, when many people migrated from Kitui to neighbouring districts in search of food
1880	drought and famine known as *Yua ya Ndata*
1898	drought and famine known as *Yua ya Muvunga*, when famine relief rice was brought from Mombasa on the newly constructed railway
1908	drought and famine known as *Yua ya Malakwe*
1914–16	drought and famine known as *Yua ya Kalungu*
1918	drought and famine known as *Yua ya Imili*
1924-25	drought and famine known as *Yua ya Kukwatwa Syua* (solar eclipse)
1928-30	prolonged famine known as *Yua ya Nzalukangye na Kakuti* due to drought and locust attacks
1942	a great famine that extended to central Kenya; many people relied on cassava for food
1944–47	prolonged famine known as *Yua ya Mwanga* due to drought and locust attacks
1949-50	drought and famine
1959-60	drought and famine
1961	famine due to severe drought followed by flooding, known as *Yua ya Ndeke* because relief food was dropped from the air
1966	drought and famine
1970-76	prolonged Sahelian drought causing serious famine in Kitui and other dry areas of Kenya
1984	drought and famine
1992	drought and famine
1997	drought and famine

Source: National Environmental Secretariat 1981 and Francis M Kioko

communal land has come under the government programme for demarcation and registration of individual ownership. The programme is not yet complete, but demarcation of individual holdings has eliminated most of the communal areas. This has coincided with a rapid population growth of nearly 3% per annum.

Dissecting the plains are winding valleys with wide, sandy riverbeds and branching tributaries draining the higher ground. During the rainy season, surface water may flow for a few weeks or even months if the rains have been good, but usually flow is confined to a matter of days or hours during heavy rains, after which the water sinks below the level of the sand. People are accustomed to digging holes in the sand and scooping out the water, but as the dry season progresses the water level continues to drop, holes have to be deepened, and the difficulty of getting water for domestic use and livestock increases greatly.

During the past 50 years, various approaches to improving the availability of water have been tried, but their overall impact has been limited. The District Environmental Report for 1979 lists 59 earth dams in Central Kitui, of which 43 were silted up or broken. The same report lists 29 springs or wells, 19 rock catchments and 8 boreholes in the same area. The failure of earth dams reflects the serious problem of land degradation, which has affected much of the district. Drought coupled with heavy pressure of livestock has led to denudation of the ground cover and high rates of erosion. Soils in the district are among the most erodible in Kenya. Although progress is now being made in soil conservation, there is little reason to concentrate on earth dams when their life span is known to be short. Even when a dam holds water and is not silted, the loss due to evaporation approaches 2,000 mm a year in contrast to rainfall, which rarely exceeds half that amount. Rock catchments have proved useful where there are suitable sites, but these are not abundant except in the south of the district. Boreholes are costly to install and maintain and have a major limitation due to the geological formation, which comprises metamorphic rocks such as schists and gneisses of the basement system. These rock formations are the result of heating, folding and squeezing of the earth's surface about 600 million years ago. In the process they became highly compressed. Unlike the younger volcanic formations in central Kenya, which have large aquifers and great scope for boreholes, the old rocks of eastern Kenya have fewer aquifers and much less scope for exploiting groundwater from deep levels unless one is lucky and hits a shatter zone.

Although the prospects for earth dams and boreholes are poor, possibilities do exist for improving water supplies by harvesting from roofs, by digging shallow wells up to, say, 25 m, and by constructing barrages – artificial barriers – in sandy rivers. That SASOL has concentrated on the last two options is explained by the observation that rainwater harvesting from roofs may not suffice in seasons when the rains fails whereas water in shallow wells and sandy rivers can persist from one season to the next. SASOL has therefore focused first on improving the retention of groundwater through installing barrages in sand rivers, second on improving the availability of water through shallow wells, and third on improving the recharge of groundwater through better land use and conservation.

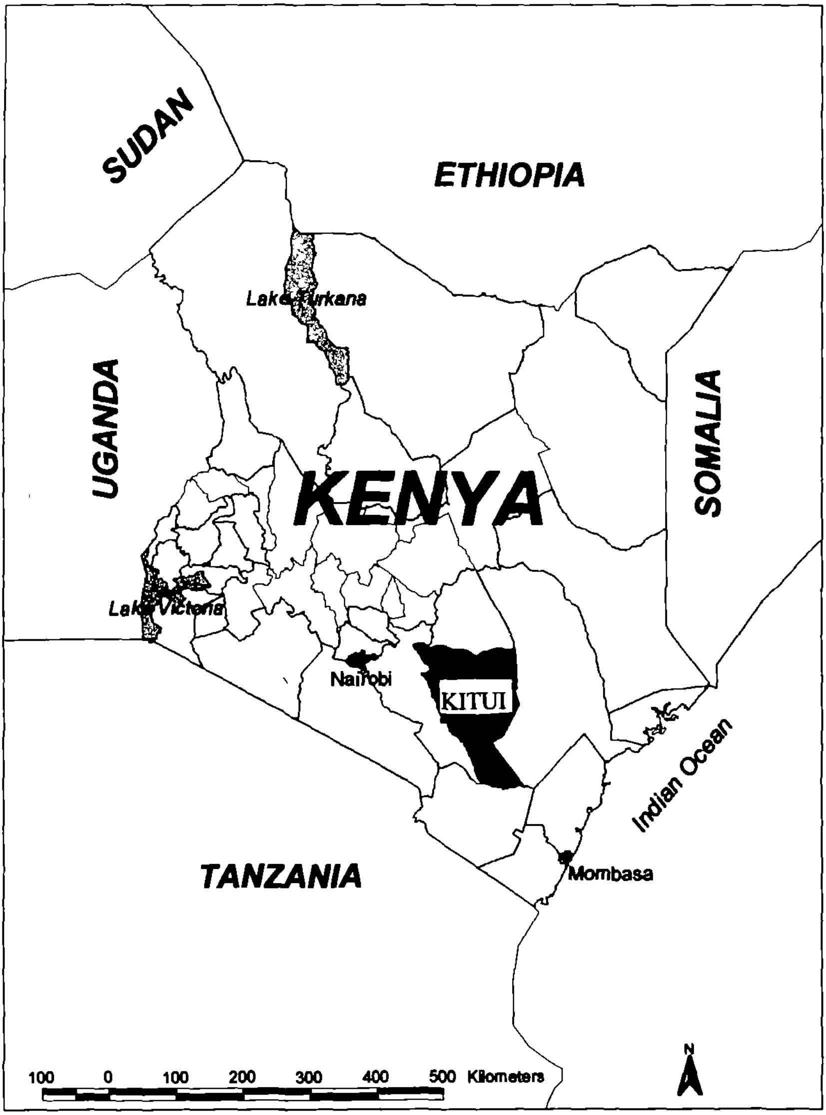


Figure 1.1 Location of Kitui District in Kenya

Rainwater harvesting from roof catchments is fairly easy to justify where there are school buildings with a big roof area and a concentration of users – the schoolchildren. For the population as a whole, the cost of storage tanks at homesteads is often prohibitive Water can be made available at a much lower cost per head and with greater reliability through shallow wells and river barrages

Although individuals who can afford to do so will construct their own roof catchment tanks, the majority of people in Kitui have little money to spare. Many houses have thatched roofs, and farming is basically for subsistence crops such as maize, beans, cowpeas, pigeonpeas, pumpkins, mangoes, bananas and pawpaws. Conditions are good for growing cotton as a cash crop, but the cost in labour and pesticides is high and the market uncertain. The very few who have enough water to irrigate small gardens grow tomatoes, onions and kale for the local market Export of food crops is not common and import of food is a regular necessity. From time to time, famine relief has to be brought in. Because of the harsh environmental conditions and the absence of industry, the majority of young, able-bodied men seek work outside the district in Thika, Nairobi, Mombasa and elsewhere, from whence they remit money to maintain their families and educate their children. As a consequence, 65% of the households are female headed. Colonial records suggest that this phenomenon has persisted since the 1920s.

With rising population, the ratio of livestock to people has fallen. Cattle, for those who are fortunate to possess them, provide the draught power for cultivation and some milk for home consumption; goats provide a form of savings that can be drawn on when cash is needed. Those who have donkeys use them for transporting water, but for the majority water is still carried in 20-litre jerrycans supported by a strap around the head. When drought takes hold and the nearer sources of water have dried up, people walk longer and longer distances – sometimes even 10 km – to fetch water from the bigger sandy rivers where it can still be found. The restrictions imposed on the use of water and the time and energy consumed in its collection have major implications for nutrition, for health and for education of girls, who are commonly withdrawn from school at such times to help with fetching water.

The constraints to development caused by the insufficiency, poor distribution and poor quality of water provided the impetus for establishing SASOL and for initiating a major effort to bring clean water within 2 km of every home. For those living in cities with piped supplies of treated water, this may seem a modest goal, but for those in the drier parts of Kitui District, it can open doors to progress and give hope to those who struggle for their basic needs.

Photo 1. Trekking with donkeys to collect water

Photo 2 Collecting water with ox-drawn sledge

Chapter 2

Vision and approach

SASOL stands for Sahelian Solutions, a name coined by Cyrus Mutiso, a political scientist, Sam Mutiso, an industrial chemist, Peter van Dongen, a hydro-geologist, and Jaap van der Zee, an environmental planner, to indicate the breadth of their vision. They have seen the droughts and famines that have afflicted Ukambani. They have watched a succession of donor-driven development projects that have come and gone with so little impact on the lives of the people They have seen how soil and water can be conserved by terracing, how fertility can be maintained, and how a small area can yield abundantly and profitably by planting fruits and caring for the soil. They have seen what hard work and determination can do, and they believe that the situation facing people in the dry areas of Kitui can be transformed.

That they have focused their minds on the rural areas and the challenges facing peasants in the drier parts of Ukambani indicates their grasp of reality. Development that serves the needs of those in power and leaves the lot of others unchanged is meaningless. The slow decline in services provided to those who pay the taxes testifies to a system that is neither of the people, by the people or for the people. In taking a different stance, they have met with suspicion and resistance, but they have shown the courage of their conviction and have won the support of men and women at the village level.

SASOL's approach starts with the community. The community must define its problems, set its priorities, and make the decisions on how to solve them. SASOL's role is that of a catalyst or facilitator. SASOL recognizes that the local people in a given area know the problems they face more than anyone else, know the natural and human resources available, and know what may or may not work in a given situation By encouraging the local community to seek its own solutions rather than imposing solutions from outside, the initiative, knowledge and talents of the people are released, the community is empowered and the likelihood that development measures will be sustained is greatly enhanced.

This concept of participatory bottom-up development is being popularized due to the failure of the conventional top-down approach in which outsiders make decisions about what is needed and how it should be done, with little consultation with the people affected. But it is more than just a change in approach; it represents a fundamental change in the attitude accorded to formal education, which has tended to ignore or belittle the knowledge, wisdom and experience of those who are in closest touch with the natural world but have had little or no chance of schooling. In particular it gives women, who generally carry the greater burden of feeding the family, rearing the children and maintaining the home, the chance to participate on an equal basis with men.

The priority that SASOL attaches to water development might be seen as restricting the community's option on where to put its energies, but in the semi-arid areas of Kitui District water is basic to almost everything, and lack of water places restriction on many other activities Water is needed for drinking, preparing food, cooking, washing utensils, washing the body, washing clothes, building houses, cleaning sisal for basket weaving, starting a tree nursery, making compost, growing vegetables, spraying pesticides, rearing livestock, making bricks, mixing concrete, and making beer from sugar cane or honey. The list is endless and the need is great. Water can become the entry point for development co-operation between the local community and donors, and if the supply of water can be improved, other developments can follow.

In the first place, labour can be released to construct terraces on the cultivated land to conserve rainwater where it falls and prevent soil erosion. The contrast in crop production between well-terraced land and land on which no improvements have been made can be striking in seasons when the rains are poor. Saving 25 mm of rain *in situ* can make the difference between getting a crop and getting nothing However, the time to make terraces is during the driest part of the year, after crops have been harvested. But this is the time when fetching water makes the biggest demands Using compost made from manure and organic wastes can also make a large difference in yield, but making it requires water. Improving the water supply can therefore lead to improved land conservation and improved food production.

The second result of improving the supply of water is improvement in health Making water more readily available for washing can have a major impact by reducing diseases caused by intestinal parasites and breaking the faecal-oral cycle that is common, especially with children, in unhygienic circumstances. Education on hygiene, the importance of latrines and the need for washing follow naturally after water has been made available. Many recognize the advantage of boiling water for drinking, but fuelwood is needed to do the boiling. Trees must be planted to supply the fuelwood, and water is needed to establish the seedlings. Again, the priority for improving water supplies is easy to justify.

SASOL is not the first organization to develop water supplies in Kitui. A major project in Mutomo Division of southern Kitui, carried out with assistance from DANIDA (Danish International Development Agency), involved constructing many reservoirs for harvesting water from rock catchments. River barrages were also constructed, and masons trained through this project are making an important contribution to the success of SASOL's work in Central Kitui. Earlier, water development was carried out with assistance from USAID (US Agency for International Development), and going even further back, there are examples of river barrages that were constructed in the fifties during the colonial period and are still effective today.

What is significant about SASOL's work is first, making the community the starting point, and second, aiming to create a network of water points using shallow wells and sand dams (river barrages) supplemented by roof catchment tanks, rock catchments and other sources, so that no family need walk more than 2 km to get an assured supply. (See fig. 2.1 showing the river systems in the project area.) A third feature of SASOL's approach is to minimize overheads, currently comprising one small office building that also provides accommodation for the field director, one four-wheel-drive station wagon, one computer and one secretary typist. There are no stores for material and no housing for staff. Materials purchased are delivered straight to the community, and the masons that SASOL employs are housed by the communities for whom they are working Maximum use is made of local resources. Stone, sand, ballast, water for mixing concrete, and labour are all provided by the community. SASOL's task is to provide technical assistance in the form of trained masons and to seek financial help for cement and reinforcing that would be beyond the resources of the local community.

The vision that has inspired SASOL owes much to two particular individuals. The first is Joshua Mukusya, who resigned from the Rural Services Department of NCCK (National Council of Churches of Kenya) to take care of the family land at Kola in Machakos District in 1978 The land had been left in his hands on the death of his father. In essence, Joshua showed what could be done through community-based activity to transform the land, transform the output and meet the needs of the people for food and income. Work focused initially on creating awareness in the community of the possibilities that were before them, and on conserving and developing water resources. Construction of sand dams in rivers, construction of roof catchment tanks and terracing of steep slopes led to co-operative efforts to increase the production of food, to improve the storage and marketing of crops, to plant trees, to improve health and hygiene, to teach young people technical skills through on-the-job as well as classroom training, and to carry out extension among the laggards who had resigned themselves to a state of poverty and dependence. The success of Mukusya's project owed much to the tradition of working in *mwethya* (self-help) groups that is a well-known custom of the Akamba people. The achievements showed the potential for development that lay within the communities themselves.

A second source of inspiration came from Kambiti Farm, in one of the driest parts of Machakos District[1]. The land was desertified and degraded

[1] G-C M Mutiso and Sam M Mutiso, Kambiti Farm, (Lectern Publications, Nairobi, 1985)

until taken over by a farmer named Ngula. Together with his family he slowly and steadily transformed the dry *Acacia-Commiphora* bushland into a park-like dairy ranch, where his son, Nthuku, now keeps high-grade Friesian cows and produces milk that is marketed in Kitui 60 km away. Water has been made available by building an earth dam and by constructing masonry dams in dry watercourses. The earth dam does not fill with sediment, because Kambiti Farm manages its grazing carefully, maintaining an excellent cover of indigenous grasses on the surrounding land. All this has been achieved in conditions that are more severe than those in Central Kitui.

No doubt many other factors played a role in the formation of SASOL, but the evidence for the potential of the dry areas, once people were mobilized and water became available, was compelling.

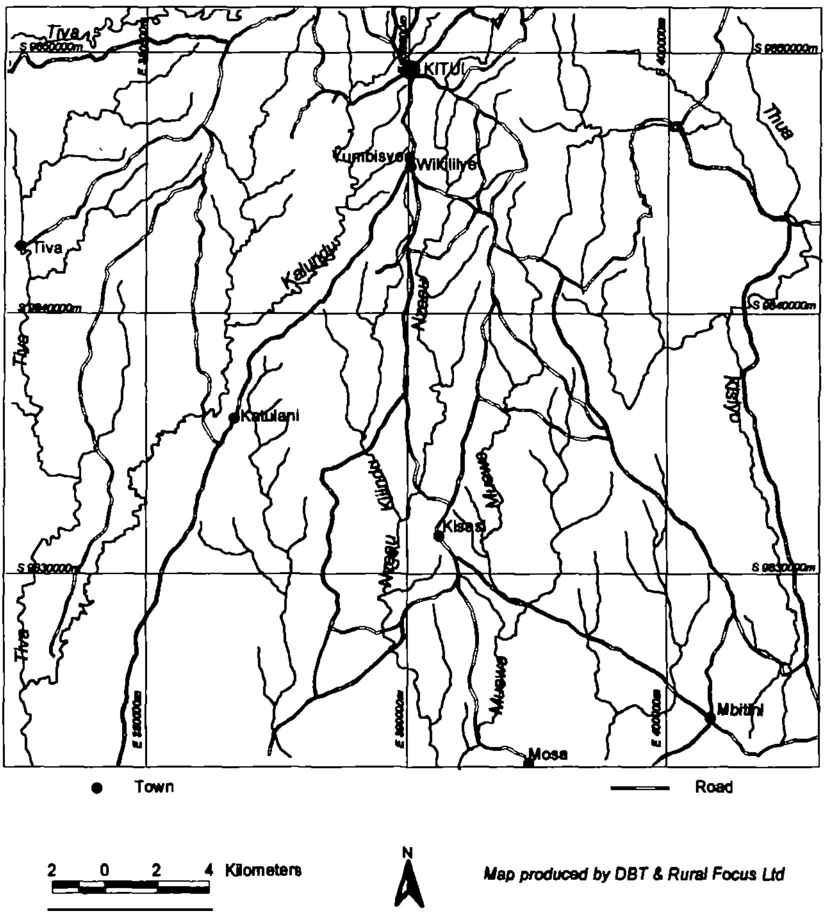


Figure 2.1 River systems in the project area

Figure 3. Rainwater tank and roof catchment at school

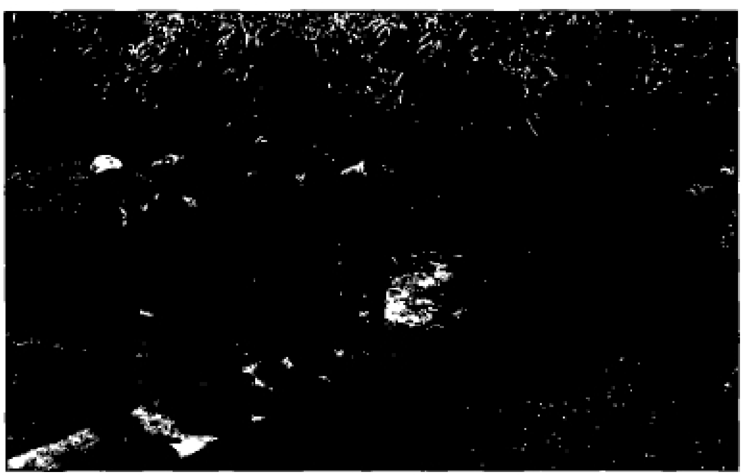


Figure 4. Sand dam in Kiindu river with Napier grass on bank

Chapter 3

Growth and achievement

The most distinctive feature of the SASOL project is the community-based construction of a large number of sand dams to conserve water in sandy rivers. But this was not the main focus at the start, since nobody would fund the dams When SASOL was founded in 1992[1], its first activity was to improve water supplies for schools through shallow wells and rainwater storage tanks. Both primary and secondary schools were included. Before giving an account of the work on sand dams, it is necessary to describe briefly the schools approach and to see how the combination of rainwater tanks, wells and sand dams is being used to create a water net

The schools programme was essentially community based, and the community agreed to provide most of the labour and materials Funding for cement, reinforcing, transport, masons and supervision came from different sources, which included SIMAVI, a Netherlands-based development agency that also funded a groundwater survey to select well sites. Additional funding came from ICS (The Netherlands) and ICAC (Canada).

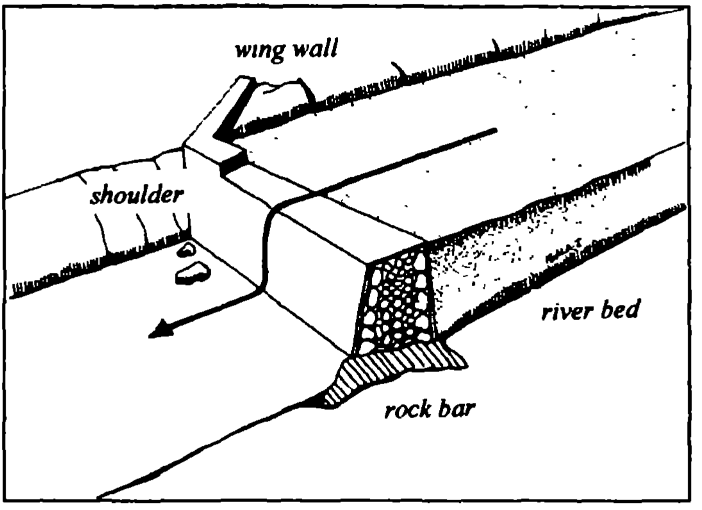
During the initial period, 12 thin-walled, ferro-cement tanks were constructed. The tanks were built close to the classrooms, and guttering was installed to carry rainwater from the corrugated iron roofs to the tanks. The cost per cubic metre of water collected in a given period was found to be much higher for a tank than for a shallow well or a sand dam. Given the unreliability of rainfall, SASOL decided to concentrate on developing shallow wells and recharging groundwater, whenever rains occurred, by promoting terracing.

For shallow wells, the community was required to dig the shaft to 10 metres and pay for a specialist well digger below that point. Once they had confirmed that water was present, the people had to fetch sand and clean water to the site, break stones for the aggregate and arrange to feed and accommodate the SASOL artisans

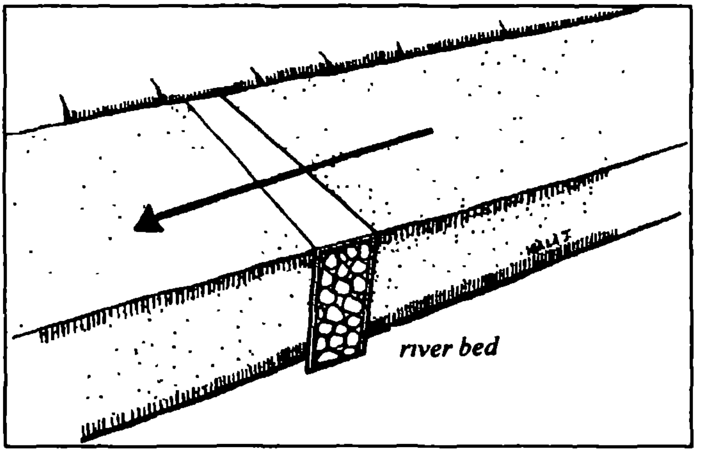
Between July 1993 and November 1994, 50 wells were installed with depths ranging from 8 to 23 metres. The average cost was in the region of 60,000 to 70,000 Kenya shillings (about 1,000 US dollars) per well, of which at least half was the cost of cement.

Shallow wells near schools can be of assistance to many people, but they also have limitations. For example, the well at Syuasini primary school is

[1] SASOL is registered as an NGO with the Kenya Government and has membership in the NGO Council



(a) Sand dam



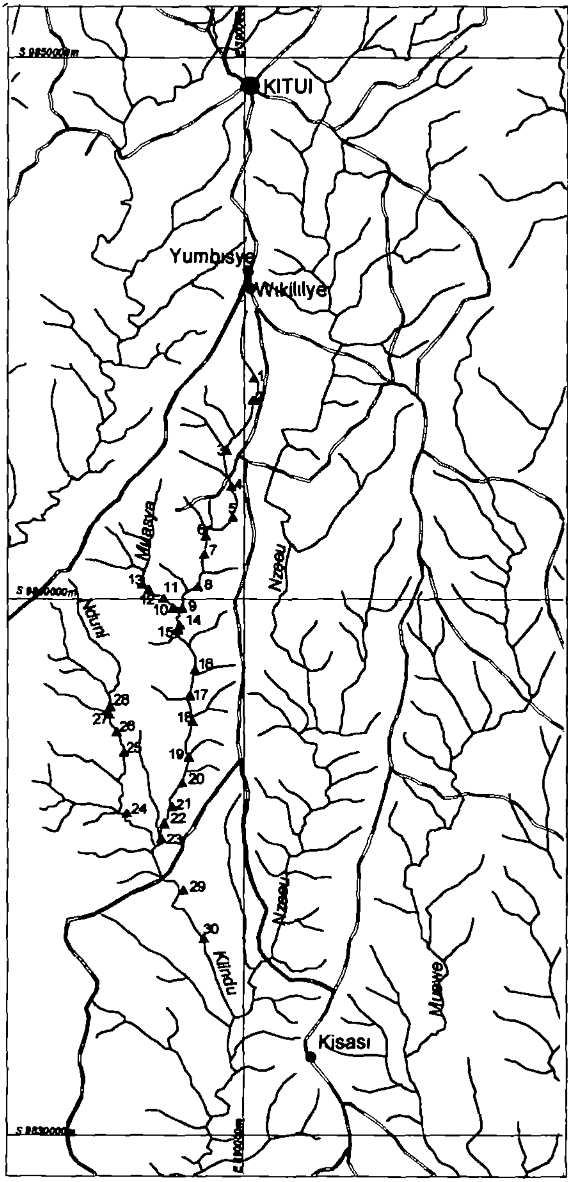
(b) Sub-surface dam

Figure 3.1 Difference between sand dam and sub-surface dam used by about 300 households and 250 children. The benefits in time saved fetching water from the river, improved quality of water and improved hygiene are substantial But the supply can dwindle in times of drought, and the quantity available is not usually sufficient for livestock as well as people.

Sand dams, also referred to as sub-surface dams or river barrages, have come to assume a much more important role in SASOL's programme of water development. They can store sufficient quantities of water for livestock and minor irrigation as well as for domestic use, and the cost per cubic metre of water stored is very much less than that for a rainwater tank. However, the quality of water can be poor unless there is an adjacent well from which filtered water can be drawn, and the burden of transporting the water can be heavy. Clearly there is no single solution to the problems of water supply and distribution, and there is much to commend an integrated approach that develops different sources to meet a variety of needs

Sand dams are not new to Kenya, but few had been installed in Kitui District before the SASOL project. The earliest were constructed during the colonial period, and most of these are still in existence. An example is the dam at Mukongwe on the Muewe River, which was constructed in 1958. At that time, they were referred to as sub-surface dams because the water is stored below the surface. However, the term 'sub-surface dam' is used in some countries to refer to a barrier below the surface. This could be a clay or masonry barrier installed below the surface in a sandy river. The term can also refer to an impervious underground barrier in a low-lying area that prevents the lateral flow of groundwater and maintains or raises the water table. In contrast, a sand dam is made as a concrete or masonry barrier on an ephemeral river, and although the upper side of the wall may be hidden by the sand, the lower side is usually exposed, in part due to excavation by water when the river is flowing (fig. 3.1). In this book, the term 'sand dam' is preferred for the structures installed through the SASOL project.

In 1994, SASOL enlisted the support of WaterAid, a non-governmental organization (NGO) based in the United Kingdom that had been directly involved in Kenya for many years. (In 1998, the Kenya programme of WaterAid was wound up, and many of its activities have been taken over by a local NGO known as Maji na Ufanisi). At the time that SASOL was looking for financial support, WaterAid was looking for an NGO interested in water recharge In February 1995, the two organizations agreed to collaborate on a pilot project to develop the necessary skills and procedures. The first pilot project proposal was to construct five sand dams and to promote tree planting and community exchange visits. WaterAid subsequently agreed to support a second proposal to install 25 barrages on the Kiindu River within Ngiluni, Kyangunga and Wikililye sublocations (fig. 3.2). Plans were made to install wells adjacent to the sand dams



	Sand dam
1	Kisekini
2	Nengy
3	Mulango
4	Kivunya Ndovoini
5	Kwa Munzao
6	Yoani
7	Kilukuya
8	Silingi ili
9	Kwa Mwini
10	Ngomano
11	Kwa Mwenze
12	Kitulo
13	Mumbuni
14	Syonganga
15	Kwa Kangesa
16	Kwa Ndunda
17	Kwa Langwa
18	Kwa Mangya
19	Nzemeni
20	Uvati
21	Kwa Mukumbe 2
22	Kwa Mukumbe 1
23	Kwa Mutinga
24	Kwa Mulumbi
25	Kwa Kilile
26	Kwa Vonza
27	Kwa Kitoo
28	Kwa Muthembwa
29	Kwa Kavoo
30	Kamumbani

● Town
▲ Sand dam
—— Road

N

2 0 2
Kilometers

Map produced by DBT & Rural Focus Ltd

Figure 3 2 Kiindu river and tributaries showing location of sand dams

WaterAid encouraged SASOL to adopt the participatory approach to development and to draw on experience from participatory activities in neighbouring Mwingi District. WaterAid also supported the decentralization of storage for materials such as cement and reinforcing materials that had been initiated by SASOL. In addition, it assisted with the development of educational materials for community training, procedures for assessing the impact of the project, and improved methods for accounting, planning, monitoring and evaluation. Funds were provided for visits to other communities that were active in water and soil conservation so that farmers were able to learn directly from other farmers. WaterAid also suggested a workshop of technical staff devoted to preparing a draft handbook on the construction of sand dams, wells and tanks.

SASOL enlisted the help of World Neighbours to train staff and to mobilize the communities through Participatory Rural Appraisal (PRA). World Neighbours is an NGO that has had many years of experience of working with communities at the grass roots in Kenya and in other parts of the world. Through the participatory process, local communities become aware of their own potential to plan and implement development. Participatory activities include collecting baseline data, training in project management and planning the management of natural resources.

The technical achievements of SASOL since its inception are shown in tables 3.1, 3.2 and 3.3 (also see fig. 3.2). Currently work is in progress to install 30 dams on the Muewe and Syuusi Rivers through partnership with Maji na Ufanisi using funds from DFID (Department for International Development, UK) and 30 dams on the Kisiiyo River with funds from Sida (Swedish International Development Authority). Plans are also being made to extend the project to the Muilini River

The achievements in improved quality of life, changed attitudes and empowerment of people is difficult to measure, but the comments of individuals shown in box 3.1 give some indication of what has been achieved. SASOL has tried hard to strengthen existing institutions such as village development committees and to encourage the communities to organize themselves, in their own way, to carry out whatever work is required for managing and maintaining the water resources. Through the participatory process, communities have been able to take stock of their own resources and to learn new ways to solve problems. They have gained the confidence needed to see themselves as actors rather than audience in the drama of development.

Box 3.1 Comments of the local people after installation of sand dams on the Kiindu river

Mzee Malonza Ndunga (an elderly man)

Before, we went to Nzeeu river in the dry season for water. The women, children and donkeys went to Nzeu from May to November. They left in the morning each day, one hour to go and one hour to come back.

Before, this river (the Kiindu) was dry but now the water is on standby full-time.

Juma Muthami (a 15 year old boy)

The water is coming up now more than before. Before no-one was growing vegetables but after the construction people are growing vegetables and fishing.

Before, the sand was down (in the river bed) and the banks were high but now the banks are near (when you stand in the river).

To build the construction, it was our mother and father who did it and they did well.

Mama Mboobi Malonza (a woman)

By now Kiindu river is good (better) than before. It is good because the water is high, people are growing the vegetables around.

Before, water stayed (in the Kiindu river) January, February, March, April and May. In June it got dry and then we went to the Nzeeu river. From here to the Nzeeu it took one hour to go and one hour to come back We went many people; we waited in line, next to next, for 30 minutes (waiting our turn to scoop the water). Children around 12 years helped me. They went to school at 7.00 am and after school in the evening they went to fetch water from Nzeeu on their backs, reaching home at 7.00 at night when it was already dark.

I am very happy because of this new mud brick house which we made since the water is near.

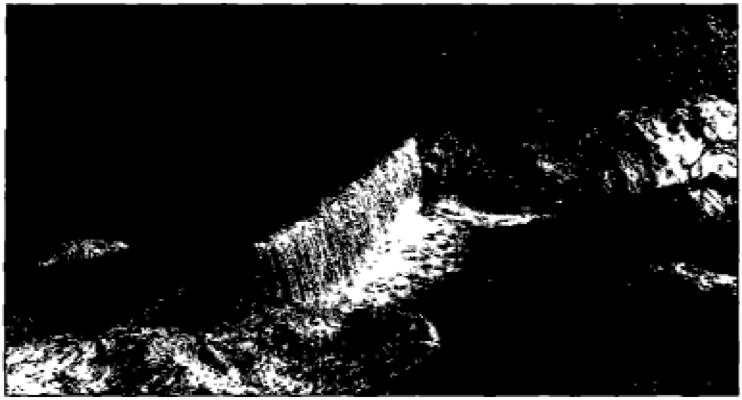


Photo 5. Sand dam on rock foundation during rainy season

Photo 6. Shallow well upstream of sand dam

Table 3.1 Rainwater tanks installed at schools

Location	School	Date	Volume (m3)	Artisan
Kisasi	Kilinyaa PS	1993	46	Mutua
Kisasi	Kisikini PS	1993	46	Mwambu
Kanyangi	Mbeetwani PS	1994	46	Mwambu
Kanyangi	Muaani PS	1994	46	Muthani
Kanyangi	Kilisa PS	1994	46	Mutua
Kyangwithy	Tungutu Girls SS	1998	46	Mulu
Township	Kitui School SS	1998	46	Mulu
Township	Kitui School SS	1998	90	Mulu
Kanyangi	Syomakanda SS	1994	90	Mutua
Kanyangi	Nzambia SS	1994	90	Mwambu
Kanyangi	Kanyongonyo SS	1994	90	Mwambu
Mulango	Mulango Girls SS	1998	90	Mulu
Mulango	Mulango Girls SS	1998	46	Mulu

PS - primary school; SS - secondary school
Note: All tanks have a domed roof.

Table 3.2 List of wells installed at schools

School	Date	Depth (m)	Artisan
Kyangwithya Location			
Kaveta PS 1	1997	9	Katee
Kaveta PS 2	1997	12	Katee
Kitui town			
Snadaa PS	1997	10	Mwambu
Miambani Location			
Mukuyu PS	1997	12	Katee
Kanzooko PS	1997	10	Katee
Miambani PS	1997	12	Mulwa
Mutula PS	1997	14	Ngei
Nzambani Location			
Kiongwe PS	1997	7	Mutua
Katumbo PS	1997	12	Kasina
Mbangulo PS	1997	4	Ngei
Inyuu PS	1997	7	Mwambu
Kiinzeni PS	1997	7	Mulwa
Kangu PS	1997	6	Paulo
Kwamutei PS	1997	14	Kaseve
Kyulumi SS 1	1996	6	Kaseve
Kyulumi SS 2	1996	5	Kaseve
Kiserini PS	1996	10	Ngei
Mulango Poly	1996	8	Kasina
Kaumba PS	1996	11	Mulwa
Kavingo PS	1996	12	Mwambu
Kalulu PS	1996	12	Mwambu
Kavutini PS	1996	10	Kaseve
Kiimani PS	1996	12	Paulo
Ngomango PS	1996	10	Kilaa
Kanzauwu PS	1996	10	Katee
Kanzauwu PS	1996	13	Kaseve
Ngengi PS	1995	10	Kaseve
Kyunduani PS	1995	7	Paulo
Kaangweni PS	1995	7	Muthami
Moi PS	1995	6	Muthami
Syombuku PS	1995	12	Mutua
Utuini PS	1995	10	Mwambu
Kavalula PS	1995	7	Kaseve
Ithumula PS	1995	14	Ngei
Kavumbuni PS	1995	13	Paulo

Table 3.2 (continued)

School	Date	Depth (m)	Artisan
Nzambani Location			
Kitui SDA	1995	9	Katee
Ikuyuni PS	1995	13	Mutua
Kilonzo SS	1995	11	Kaseve
Kiini PS	1994	9	Ngei
Mbitini Location			
Kivuuni PS	1994	9	Muthami
Makolongo PS	1994	9	Mwambu
Ikoothamwike PS	1994	8	Ngei
Kilivi PS	1994	8	Mwambu
Kamulu PS	1994	7	Kaseve
Wingoo PS	1994	8	Mwambu
Usanga PS	1994	10	Kaseve
Mbitini ABC	1994	14	Ngei
Mbitini SS	1994	20	Mwambu
Nzangathi PS	1994	9	Kaseve
Mwinzengi PS	1994	8	Muthami
Kamale PS	1994	8	Kaseve
Maangani PS	1994	11	Mutua
Kisasi Location			
Ngangani PS	1994	5	Muthami
Utawala PS	1994	6	Mwambu
Kwakutu PS	1994	5	Mutua
Kisasi PS	1994	8	Mutua
Syuasini PS	1994	9	Ngei
Ngiluni PS	1994	9	Mutua
Kitungati PS	1994	5	Ngei
Kalatine PS	1994	5	Muthami
Kisasi Youth Poly	1994	7	Muthami
Seerea PS	1994	8	Ngei
Mwiwe PS	1994	6	Mwambu
Mukameni PS	1994	5	Mutua
Kyangwithya Location			
Mbusyani PS	1993	6	Kaseve
Isaangwa PS	1993	5	Kithuku
Syongila PS	1993	8	William
Mutendea PS	1993	5	-
Mutumi Girls PS	1993	8	-
Mutumi Boys PS	1993	5	-

Table 3.2 (Continued)

School	Date	Depth (m)	Artisan
Kyangwithya Location			
Kilungu PS	1993	5	-
Kangao PS	1993	3	-
Ivaini SS	1993	4	-
Wanzoa PS	1993	5	-
Kwambo PS	1993	5	-
Kitumbi PS	1993	5	-
Kasyala PS	1993	5	-
Kwa Ukungu PS	1993	6	-
Kyalilini PS	1993	5	-
Mulundi PS	1993	5	-
Mulango Location			
Kithambangi PS	1993	12	Mutua
Yumbisye SS	1993	23	Mwambu
Sooma PS	1993	8	Mwambu
Kyandui PS	1993	9	Kaviti
Ivovoa PS	1993	6	Mwendwa
Kakuuni PS	1993	6	Kaviti
Maseki PS	1993	5	Mwambu

PS - primary school, SS - secondary school

Table 3.3 Sand dams installed on Kiindu River and its tributaries with funding from WaterAid

Dam	Date completed	Approx width/height m	Artisan
KIINDU RIVER			
Kisasi Location, Ngiluni Sublocation			
Kamumbuni	4/95	28/2.2	Muthami
Kwa Kavoo	7/95	25/-	Mutua
Kwa Mutinga	8/95	26/2.0	Ngei
Kwa Mukumbe 1	5/95	19/1.0	Mwambu
Kwa Mukumbe 2	6/95	16/1.6	Kaseve
Mulango Location, Kyangunga Sublocation			
Nzemeini	10/95	18/2.4	Mutua
Kwa Mangya	10/95	24/1.9	Kaseve
Kwa Langwa	11/95	14/2.4	Muthami
Kwa Ndunda	3/96	23/2.5	Mutua
Kwa Kangesa	5/96	19/1.8	Mutua
Syonganga	10/95	14/3.5	Mwambu
Kwa Mwini	4/96	15/2.3	Muthami
Silingi Ili	4/96	11/3.0	Kilaa
Kilukuya	11/96	19/2.4	Mwambu
Mulango Location, Kisekini Sublocation			
Yoani	11/96	19/2.4	Mutua
Kwa Munzuu	5/96	15/2.3	Ngei
Kivunya Ndovoini	2/96	30/1.3	Mulwa
Mulango	3/96	16/2.3	Mulwa
Nengya	4/96	26/1.4	Kaseve
Kisekini	6/96	17/1.4	Ngei
Sunzumala	5/96	16/1.6	Mulwa
MUSYA RIVER			
Mulango Location, Kangalu Sublocation			
Ngomano	2/96	12/2.6	Muthami
Kwa Mwenze	3/96	12/2.6	Muthami
Mumbuni	9/96	14/2.8	Mutua
Kitulu	9/96	11/0.8	Mutua

Table 3.3 (Continued)

Dam	Date completed	Approx width/height m	Artisan
NDUNI RIVER			
Mulango Location, Kwa Muli Sublocation			
Kwa Mulumbi	3/96	18/2 2	Mwambu
Kwa Vonza	4/96	22/4.3	Paulo
Mulango Location, Kwa Muli Sublocation			
Kwa Kitoo	3/96	14/3 7	Paulo
Kwa Muthembwa	5/96	16/3.2	Mwambu

Many dams have been constructed on other rivers, notably the Muewe and Kisuyo (Syuusi) with funding from DFID and Sida.

Chapter 4

Community mobilization

Community mobilization is basic to SASOL's programme for water-resource development As background to how this mobilization comes about, it is necessary to understand the administrative structure in rural areas SASOL takes advantage of existing structures and conforms to the government policy referred to as the District Focus for Rural Development.

The Kenya government has attempted to devolve authority for development activities from the centre to the district. At the top of this structure is the District Development Committee or DDC. At the next level, in each division, there is a sub-DDC, and within each division there are several locations, each having its own development committee Within the locations are sub-locations, again having their own development committees. The administrative structure is headed by a district commissioner, who has district officers in each division. The government is represented by an appointed chief within each location and a sub-chief within each sub-location.

The final level is the village, known as *utui* in the local language, Kikamba To some, the concept of village depicts a nucleated settlement. But as homes are dispersed in the rural areas of Kitui, *utui* refers to a grouping of several households, some of which are closely related. There may be six to ten such villages in each sub-location Each *utui* has a headman, who is not a salaried government employee but acts as spokesman when the need arises and acts as a link between the government and the people. Villages also have development committees, which may or may not be functional Outside this formal structure is a variety of social groupings, in particular women's groups and self-help groups of various kinds.

Before communities can be mobilized, people must be trained, and SASOL has found that training can best be done at the level of sub-location, because this draws together people from the same locality, which is small enough for matters of common concern to be identified. Typically a sub-location might cover an area of 30 km^2 and have a population of around 6,000 people.

The training follows the approach of PRA, which has become widely adopted by non-governmental organizations (NGOs) and community-based organizations (CBOs). This approach has been described in various publications, notably by Robert Chambers[1] As SASOL is heavily committed

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[1] Robert Chambers, *Whose reality counts?* (Intermediate Technology Publications, London, 1997)

Box 4.1 Trend analysis - example quoted from Ngangani Sub-Location PRA report (March 1997)

Rain

"From the year 1960-70 the rains were plenty and quite reliable. By 1980-90s the rains started reducing and skipping, hence making the land yield little. By the year 2000 due to the expected change in tree planting and conservation, being enforced by man, there will be adequate rains".

Population

"From 1960s to 1970s the population growth was very low and people had enough By 1980s-90s the population growth doubled. By the year 2000 the population growth is expected to be controlled if family planning is followed".

Harvest

"From 1960s to 70s the harvest was plenty and enough throughout the year. From 1980s to 90s the harvest decreased and people started starving. By the year 2000 there will be good harvest since people are being encouraged to practice soil and water conservation".

Soil fertility

"By 1960-70 the fertility of the soils was very high and many crops did well. By the year 1980-90s changes in soil fertility were noticed. At present most soils are poor and produce nothing. By the year 2000 there will be some change since a lot of effort is being done on soil conservation".

Trees/Forests

"From 1960-70s there were many trees and thick bushes. From 1980-90s people continued cutting down trees and left very few. At present there are few trees. By the year 2000 there will be trees since people are being encouraged to practice afforestation".

Farms

"From 1960-70s the farmers were small with good yields. From 1980-90 farms enlarged and the yields decreased. Today there are big farms which yield nothing. By the year 2000 the farms will be small as the population rate will be too high".

to implementing water projects, the PRA training is facilitated by staff of World Neighbours

The community selects from 25 to 50 trainees, both men and women. The training lasts from five to eight days and follows a well-defined pattern. At the start, the trainees appoint individuals from within their group to take responsibility for timekeeping, recording, controlling discussions, organizing meals, and so on. The first activity is to prepare maps to show the social setting, the resources of the area and other aspects of importance. A second activity is to collect basic information, as shown, for example, in tables 4.1 and 4 2, taken from two different PRA reports. Another activity is to prepare a time line showing major events such as droughts, famines or floods against a chart of years. This leads naturally to an analysis of trends, and it changes when participants record their observations on changes in population, land use, fertility of the soil, availability of food, water, fuelwood and so on (box 4.1). All this baseline information provides a point of reference for future comparison after developments have taken place. Although not everything can be quantified, a consensus among the people about what is happening to their environment is a powerful tool in reaching agreement on priorities for development.

The next step is to record the seasonal calendar (box 4.2) to show how activities such as planting, weeding and harvesting are distributed throughout the year. This leads to finding out how much time is spent on different activities by men, women, boys and girls during the day. Almost invariably, men are shown to bear less of the burden of supporting the family than women (box 4.3).

All these exercises help the participants to reflect on their own situation and to understand their areas of strength as well as their areas of weakness. Lack of adequate foresight in planning for food security is a common finding.

The next stage involves identifying problems facing the community and analyzing the reasons for the problems. Further activities include studying institutional links using Venn diagrams to show the relative size, proximity and connection between the various institutions with which the community is, or might be, involved. Matrix ranking using two-way tables is also used, for example, to document the value of different trees (table 4.3). Columns can be used for different species and rows for the various attributes such as firewood, shade, poles, fruit, and so on. Each box within the matrix is assigned a score from 1 to 5 or 1 to 10 to indicate the importance of a given tree for a particular use.

Having completed all these exercises and others that may be needed, the participants carry out an impact analysis to determine which development activities are likely to have the greatest impact.

Box 4.2. Seasonal Calendar - example quoted from Wikililye Sub-Location PRA report (July 1996)

"In the month of January there is plenty of food in the shambas, i.e. beans, green vegetables, fruits such as mangoes, guavas and pawpaw. In February the beans are ready and they start harvesting up to March. During this period, there is malaria breakout due to a lot of mosquitoes which come from the rotten fruits. In the month of April is when they do celebrate for Easter holiday and have wedding ceremonies. In the month of May they start harvesting of maize up to July[2]*. In August they have dry season where they do a lot of work like cultivation, brick making and cutting of firewood to be used during he rainy seasons. During the month of September they start harvesting pigeon peas while preparing their shambas ready for the rains In October they start early planting and in mid October they receive the long rains In November to December people are very busy in their shambas and at the same time they do have many wedding ceremonies, parties and celebrating of Christmas holiday while waiting for the new year to begin and the cycle revolves again as they come to the new year".*

This analysis leads to setting priorities and developing an action plan, which is the culmination of all that has gone before. Almost invariably, the shortage of water is the first problem identified, and the action plan therefore addresses ways and means of tackling the problem – not only to increase the quantity and availability of water but also to improve its quality.

Once agreement is reached on a strategy for water development, the next step is to make plans with the community that will be responsible for implementation. For example, the community that would benefit from a new sand dam might comprise two or three villages. The community elects a chairperson (often a woman) and a storekeeper. The chairperson works with the village headmen to assign tasks. The community has to arrange for the delivery, storage and recording of materials such as cement or reinforcing bars that SASOL purchases They have to provide accommodation and maintenance for the artisan whom SASOL assigns to the group.

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[2] The maize which is harvested in July would have been planted in March or April but the main growing season for maize is the November – December rains

Box 4.3. Typical daily schedule of activities-example quoted from Wikililye Sub-location PRA report (July 1996).

Women *"The woman always wakes up at 5 30 am to start her daily chores After waking up, the woman brushes teeth and washes the face. After that, she sweeps the kitchen, takes milking utensils to go and milk the cows at 6 00 a m. Since she had left the kitchen clean, she lights some fire and starts preparing breakfast At 7 00, she serves tea to her family. When breakfast is over she cleans the utensils, prepares food for her young kids, rushes to the river to fetch some water and this goes up to 9 00 a.m From there, she goes to the shamba where she works for three hours and comes back at noon She rests for a few minutes and starts to prepare lunch When it is ready, she serves it to the family members. After lunch she rests while making her kiondo [sisal basket] up to 2.00 p m. From 3.00 p m., she joins the third session of her programme. She prepares supper and goes to collect some firewood while her small girl puts fire on to keep the pot boiling. After half an hour, the woman comes back from the forest At 5 00 p.m , she cleans the utensils that had been used during lunchtime, bathes her young children, washes their clothes and goes to bring home the goats and cattle During all that time the woman has not bathed She goes to the bathroom to bathe. When she finishes, she rushes to the kitchen to prepare supper early enough for her small children They start taking the supper at around 7 30 p m. At 8 00 p.m the young ones go to bed. The woman is left behind cleaning utensils Since it is too early for her to go and sleep, she picks her kiondo and continues weaving till 10 00 p m and goes to sleep till the following morning".*

Men *"The man wakes up at 8 00 a.m., washes his face, brushes teeth and takes breakfast up to 9.00 a.m. From there, he goes to the shamba where he works for three hours and comes back home He rests while waiting for lunch to be ready. After taking lunch from 1 00 to 2.00 p.m. he rests while sleeping. From 2.30 p m. the man goes to bathe at the river up to 3 00 p m. He comes back, dresses properly and goes out for the evening walk. Some men go to visit their friends, others to the nearby canteens to share stories with their colleagues, and others go to take beer".*

To establish understanding and close co-operation between the artisan and the local community, it has been found useful for the artisan to participate in the PRA activities.

During construction, the able-bodied members of the community are split into two or more working groups, and the groups rotate from day to day so that the task of construction continues but the work at home or in the fields is not neglected. Records are kept of those who attend, and discipline is exercised by fining those who are late or fail to appear.

Traditionally, water is the responsibility of women, but the PRA training provides an opportunity to show that men are often not fully occupied and have a responsibility together with women for developing water resources. Men carry out the heavier tasks of dam construction such as digging foundations, breaking rocks and hauling large stones. Women fulfil other task such as carrying water (if it is not available at the site while the dam is being constructed) and small stones, washing stones, mixing the sand and cement mortar, and cooking food on site. The workers keep regular hours, and women prepare food in the middle of the day for lunch. As many of the younger men are working outside the district, work is sometimes delayed while the older men break rocks. At these times, the women are called in only when there is work for them to do.

The work of construction is hard, and effort may slacken as the work nears completion. This can affect the construction of the wing walls, which confine the river to the centre of the channel. On many sites such wing walls are important in preventing the river from cutting a new channel around the end of the barrage. Their proper construction is therefore vital. One way to keep up the level of community activity is to start with the wing walls and work towards the centre. This is psychologically attractive, because the gap in the centre gets smaller and smaller as the work proceeds and the obvious need to fill the middle is a constant stimulus to finish the job. Another advantage of this procedure is that it allows work to begin sooner after the rains, even when the water level in the river would make starting in the centre difficult.

The river barrages increase the quantity of water available, but other measures are needed to improve the quality of water. Although water drawn from scoop-holes in the sand may look reasonably clean, it is likely to contain pathogenic micro-organisms. Reducing contamination should be a priority. One way is to keep the places where livestock come to drink separate from places where people extract their water. Another way is to construct pit latrines at all homesteads so that runoff does not carry faeces into the river during rainy periods.

If there is sufficient firewood available, water for drinking can be boiled-and many people do boil it. This emphasizes the need to plant trees for firewood. Once water is permanently available in the river, tree nurseries can be established; however, the best techniques for establishing seedlings are not widely known.

In one instance, this problem was tackled by taking villagers to study tree nursery techniques used by the Kutethania Women's Group at Kivauni in neighbouring Machakos District. The visitors were shown how to make compost, select species, prepare seedbeds and plant seeds. They learned how to make tubes from banana leaves and how to transfer the seedlings to the tubes. They saw how trees should be planted and cared for in the field and how damage from termites and other pests could be controlled This farmer-to-farmer learning has been shown to have much greater impact on rural development than conventional extension programmes.

Completing a sand dam and installing a well upstream from which clean water can be drawn opens new doors for raising tree seedlings, growing vegetables and improving health. But it can also generate new challenges. Who, for example, has the right to grow fodder grass along the riverbank? Who can have access to land for a tree nursery or a vegetable plot?

Who will take responsibility if a leak appears in the dam wall, and who will ensure that the well windlass is kept in working order? Only the community can answer these questions. Therefore, it is essential that a strong community-based organization continues to exist.

Village development committees are often weak, and for the future of water development, catchment-based water-user committees have greater potential. A water-user committee represents those who draw water from a common source and have interests in protecting and managing that resource. It usually represents people from several villages on both sides of the river. Such committees can evolve from the site committee that comes into being at the time a dam is constructed, but it should continue not only to maintain the work that has been done but also to promote improvements in soil and water conservation, food production and health, which are so closely related to water.

With this in mind, SASOL arranged a one-day visit for 30 people from the Kwa Muli Sub-location in Kitui to visit the Kionyweni community in Machakos District, to see the way in which it had carried out soil conservation, improved food security and raised incomes. Again, water-resource development becomes the entry point for many new activities SASOL acts as the catalyst, but the communities themselves move forward, relying mainly on their own resources and a new sense of their own potential.

Photo 7. Communıty traınıng through PRA

Photo 8. Food preparation at work site

Table 4 1 Baseline data for Matua Kitungati Sub-location

Villages	Maani	Kituganti	Manzini	Inyali	Matua
Households	98	92	93	82	88
Population	518	280	436	461	446
Households with terraces	17	15	14	31	23
Food-sufficient households	5	7	7	9	16
Primary beneficiaries	all	all	all	all	all
Households not using river	none	none	none	none	none
Time, distance to fetch water	1 hr 3 km	1 hr 3 km	1 hr 3 km	2 hr 6 km	1 hr 3 km
Households with livestock	38	8	18	39	23
Number of cattle	138	114	94	79	n a
Number of goats	158	96	171	172	n a
Number of donkeys	41	50	25	n a	n a
Depth water in dry season	10 ft /3 0 m	8 ft/2 4 m	9 ft/2 7 m	4 ft/1 2 m	5 ft/1 5 m
Existing dams or wells		7 wells			
Tree nurseries					7
Vegetable gardens	8	9	4	12	14
Households with toilets	71	19	10	24	18

Table 4.2. Village status report-example from Ngangani Sub-location PRA (March 1997)

Village	Homes (no.)	Homes with well-terraced land	Homes with planted fruit trees	Homes with planted fuelwood trees	Homes with good harvest
Ikuyuni	32	7	11	3	3
Kathini	24	0	4	5	0
Katumo	56	15	26	30	0
Muambani	43	3	7	8	4
Muangi	31	7	8	8	2
Mutuyu	46	8	6	5	3
Mwiwe	28	5	3	3	4
Ndiamu	54	2	10	3	2
Ngaiyoni	14	1	1	0	0
Syuasini	38	1	13	13	1
Ulungu	64	8	10	13	2
Wingoo	19	0	4	4	

Table 4.3. Matrix ranking of trees-example from Wikililye Sub-location PRA (July 1996)

Kikamba name	Firewood	Shade	Fruit	Building	Browse	Medicine	Income	Tolerance to drought	Resistance to pests	Total	Rank
Lukenya	10	8	0	3	9	0	8	6	5	49	
Muembe	10	10	10	1	3	0	10	9	7	60	4
Muluvaini	10	8	0	2	3	10	4	7	5	49	
Musemei	10	9	0	10	9	10	5	9	6	68	2
Musungwa	10	10	10	7	2	0	10	5	8	64	3
Muthumula	9	10	10	7	5	7	10	9	10	77	1
Mutimu	8	10	10	2	3	0	10	7	5	48	
Mutoo	10	10	6	10	7	0	0	10	7	60	5
Muvavai	0	3	10	0	5	7	10	8	7	48	
Muvela	8	9	10	0	2	0	10	8	7	54	6

Botanical names. Muembe, *Mangofera indica* (mango), Muluvaini, *Azidirachta indica*, Musemei, *Acacia nilotica*, Muthumula, *Tamarindus indica*, Mutoo, *Dombeya rotundifolia*, Muvila, *Gnidia latifolia*

Chapter 5

Design, construction, maintenance

The success of the project depends foremost on the quality of workmanship that the artisans show. Several measures have been employed to ensure that construction is carried out to a high standard. The masons selected have all had basic training in building at various technical institutions. Many have also gained experience in water-resource development while working in Mutomo Division, southern Kitui, in a project that was funded by DANIDA. Further training in sand dam construction took place under the supervision of David Kithuku (nicknamed 'British') during the pilot phase on the Kiindu River.

Whereas the design and construction of wells follows a regular pattern, the procedures for sand dams are much more variable. Each site is different. Rivers vary in width and discharge. Rock foundations vary in depth and susceptibility to leakage. Riverbanks may be high or low, and the need for wing walls has to be carefully assessed.

Within each river catchment, there is one experienced artisan who acts as leader. He inspects the work in progress and keeps a record of materials used. Every month there is a staff meeting at which the artisans report on progress and give an account of the materials used. Once a quarter there is a meeting of all artisans to review progress and discuss any problems that may have arisen. Twice a year the artisans tour all the project sites as a group and evaluate each other's work. In this way, a high standard of workmanship is maintained, and any artisan who fails to maintain the standard of his peers is discharged.

In 1997, a workshop was held at which the artisans were given the task of preparing guidelines for design and construction in which they combined technical information with their own knowledge and experience. The following material is based on the guidelines prepared and includes some of the key points that would be important for anyone planning to dig wells or build sand dams in another area.

Sand dams

The local community has to take the initiative, indicate the stretch of river where water storage would be most useful, and agree to provide the labour needed. The community assists in looking for a suitable site where the river is naturally confined between banks even when in flood. There should also be a

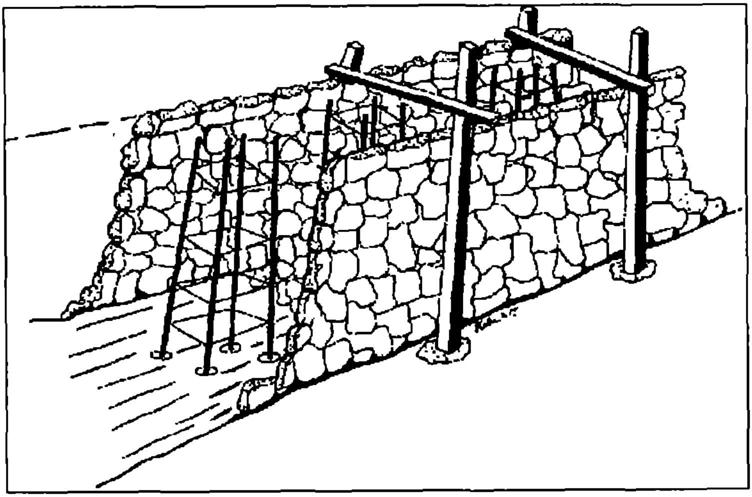

Figure 5 1 Sand dam construction showing reinforcing

rock bar that goes through the riverbed and is, as far as can be ascertained by probing with an iron rod, not fractured

Such rock bars are the best foundation and occur quite frequently in the area, but there are some sites where a dam is needed that have no rock bar. In such circumstances, construction is more difficult and the risk of failure is greater. Dams that are constructed where there is no rock bar should not exceed 0.5 m above the existing sand level. The details given here are for a rock bar site (fig. 5.1).

The height of the dam is usually about 1.5 to 2 m in the centre, but in a few instances dams up to 4 m have been constructed. At either end of the dam, the wall is raised to prevent the river cutting round during a flood. Where the valley sides are flat, wing walls may be added at an angle to the main dam for the same purpose. Each site is different, and the design has to be modified accordingly, but the basic principles are straightforward.

Once the site is selected, a trench is excavated down to the rock bar. The wall is normally constructed with a base width of 150 cm and a top width of 75 cm. The upstream side is vertical and the downstream side angled. Using a hose-pipe water level, the mason fixes a string between pegs on either side of the river to mark the top of the wall and sets up timber frames at intervals across the river for attaching strings and guiding the construction.

Box 5.1. Cost of construction of a typical sand dam

Figures are based on a typical sand dam with a main wall 26 m long and wing walls of 5 m on each side. The height of the dam is 2.5 m in the centre. The width of the wall is 1.5 m at the base and 0.75 m at the top.

Construction costs

Item	Quantity	Unit price (Sh)	Cost (Sh)
Materials			
Cement	200 bags	530	106,000
Barbed wire 25 kg 16 g	2 rolls	2,250	4,500
Round bars 12.5 mm	6 pcs	450	2,700
Round bars 6.25 mm	6 pcs	290	1,740
Cypress timber 2" x 2"	30 m	23	690
Nails 4"	1 kg	70	70
Subtotal			115,700
Artisan 2 months @ Sh 5,000			10,000
Supervision and monitoring			30,000
Community organization and training			40,000
Total			195,700
Community contribution			
Labour 900 days @ Sh 100			90,000
Maintenance of artisan for 2 months			6,000
Total			96,000

Notes

* The community members are not paid and they also contribute sand, stone and water, which are difficult to value. The figure for labour is shown simply to indicate the proportion of cost borne by the community.
* The time invested by the community in community organization and training, which is important for the sustainability of the project and future development, has not been costed.
* Assuming that the reservoir extends upstream for 250 m from the dam wall, that the gradient of the river bed is 1%, and that the volume of water stored is 35% of the volume of sand, the maximum volume of water stored would be 26 x 2.5 x 250 x 0.5 x 0.35 = 2,844 m^3. The construction cost in this instance is equivalent to 195,700 ÷ 2,844 = approx. Shs 70 per m^3.
* The above costs were obtained when 1 US dollar = 60 Kenya shillings (approx.)

Reinforcing columns (approximately 40 cm x 40 cm in cross-section) are fabricated using four round iron rods (12.5 mm diameter) and binding wire These reinforcing columns are placed at intervals of about 2 m across the length of the dam wall and firmly grouted into holes (50 mm deep) that have been cut with a chisel into the foundation rock. A layer of cement sand mortar (1:3 mix) is then spread on the foundation to a depth of 50 mm and 12 strands of barbed wire, spaced 75 mm apart, are laid lengthways along it. The wires are covered by a further 50 mm of mortar

Building now proceeds in stages by constructing the wall faces to a height of about 1 m and then filling the middle with masonry comprising hardcore (broken stone) and mortar (1·4 mix). The faces are built by placing carefully selected flat rocks on edge. The local gneiss is used for this purpose, as it is hard and can withstand wearing by abrasive floodwater The joints between the rocks are filled with about 25 mm of mortar As the downstream face is sloping, the rocks have to be propped in position with sticks until the mortar sets.

After each addition of 30 cm to the wall, 12 strands of barbed wire are laid lengthways as before. The top of the wall is covered with a layer of plaster, 15 cm thick, rounded at the down stream edge to prevent cavitation. The wall on the upper side is also plastered to ensure that the dam is watertight, and an extra thickness of plaster is laid at the foot of the wall on either side for the same purpose.

The success of the work depends on careful attention to detail. All rocks must be washed before use. Sufficient spaces must be left between them to ensure that they are properly bedded in the mortar, which should be well mixed in the correct proportions of sand and cement. The mortar that is used for filling the middle should be wet enough so that it can be properly packed into the gaps around the hardcore. Keeping the structure wet during construction and allowing proper curing for three weeks afterwards is particularly important because of the hot sun and dry conditions that usually prevail. Women make a major contribution to this effort, for more often than not they have to walk from 1 to 10 km to fetch the water.

If a sand dam has been well constructed, there should be little or no maintenance. However, it is necessary to check after floods and repair any damage that is found Most of the completed dams withstood the exceptional rains and floods that occurred in 1997 and the first half of 1998. In a few instances, the river cutting round one end damaged the structure. This showed that the wall should have been higher at that point or that the barrier should have been extended with a longer wing wall.

Construction of sand dams in stages, with the dam being heightened about half a metre per year, is sometimes recommended. This method is said to ensure that only sand is deposited and the silt and fine particles, which could

Box 5.2 Points to check when constructing sand dams

- * Make sure that the rocks used for hardcore are clean
- * Leave 25 mm of mortar in joints between rocks used for facing the walls.
- * Leave sufficient spaces between rocks used for filling the middle to ensure that they are properly bedded in mortar
- * Use the correct proportions of cement to sand (1.4 for normal purposes or 1 3 where extra strength is needed) and mix thoroughly before using.
- * Use just enough water when mixing (but no more than necessary) to ensure that the mortar can be packed tightly into the gaps between the rocks.
- * Keep the structure wet during construction.
- * Continue wetting three times a day for three weeks after construction to allow proper curing.

otherwise reduce the storage capacity, are carried on downstream. This procedure has not been adopted by SASOL because of the cost and the problems that would be involved in mobilizing the community on several separate occasions. Experience so far indicates that there is minimal deposit of sediment other than sand.

Abstracting water from sand dams can be done using scoop-holes, but to improve the quality, water is best taken from a shallow well, as discussed in the next section. Outlet pipes passing through the dam wall were sometimes used in the past for drawing water from sand dams, but experience shows that the tap is often left open or gets broken and water is lost. In other situations, the intake gets blocked. Because of these problems, SASOL has not attempted to install piped outlets.

The construction of sand dams where there is no rock foundation is sometimes necessary but is likely to succeed only if the foundation trench is cut into impervious clay and if the wall is not built more than about 0.5 m above the existing sand.

Shallow wells

Shallow wells have been installed in two different kinds of places: 1) near a school or 2) either beside the river or within the riverbed where sand dams have been constructed. The two situations call for slightly different procedures

School wells

The site is chosen with the aid of a local dowser with a forked twig or a hydrogeologist with a resistivity meter. Sometimes both may be employed for cross-checking, as it is expensive to dig a well and fail to get water. After the site is selected and cleared, a circle of 1 m radius is marked out, and digging begins. Well digging is a skilled task, and local specialists are hired for the job. While the digging is going on, the local community is collecting the necessary sand, hardcore and ballast – the latter usually obtained by breaking quartz rocks.

The work of construction requires that four components be fabricated: 1) a concrete ring on which the well shaft will be built, 2) concrete blocks for the shaft wall, 3) a well cover for the top, and 4) a lid for the access hole (figs. 5.2 and 5 3).

The concrete ring has an outside radius of 75 cm and an inside radius of 55 cm. The width of the ring is 20 cm and the thickness 25 cm. The ring is made in a circular trench carefully dug to the correct dimensions. A concrete mix of cement, sand and ballast (1:3:4) is used, and six rounds of 3-mm galvanized wire are used to provide reinforcing. Additionally, 16 vertical pieces of wire 60 cm long are attached to the reinforcing for fixing ropes when lowering the ring into the shaft. The ring is kept wet for seven days to cure the concrete.

The concrete blocks are made in a specially fabricated mould with curved sides. The blocks are 15 cm high, 10 cm wide and 50 cm long. The concrete mix is the same as for the ring. The blocks are placed on a plastic sheet and kept wet for seven days for curing.

The well cover is made with a diameter of 150 cm and a thickness of 10 cm; it has a hole 60 cm in diameter in the middle. This hole will be used for drawing water. An additional smaller hole, 10 cm in diameter, is made to one side as a breather hole to allow an exchange of fresh air. The cover is cast in an excavation in the ground The same concrete mix is used as before together with 8 rounds of barbed wire connected by 31 shorter pieces for reinforcing.

The well lid to cover the centre hole is made in a similar manner with barbed wire reinforcing but is only 50 mm thick. It has two handles made from round bars for lifting

Well digging is normally carried out in the dry season when the water table is at its lowest. When a sufficient depth has been reached, the well ring

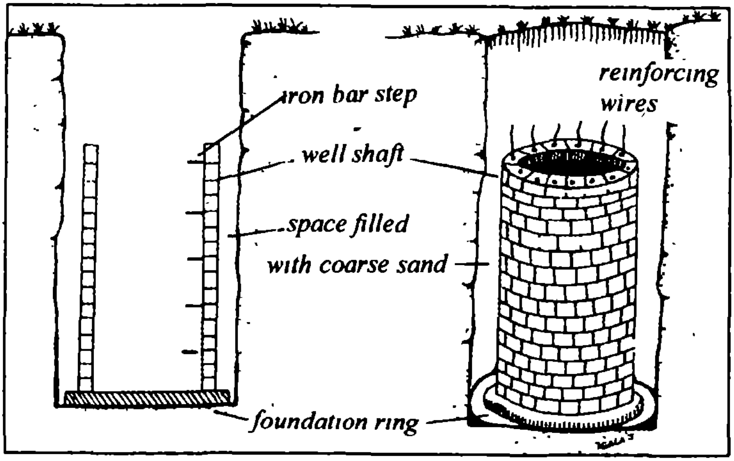

Figure 5.2 Method of well construction from bottom up

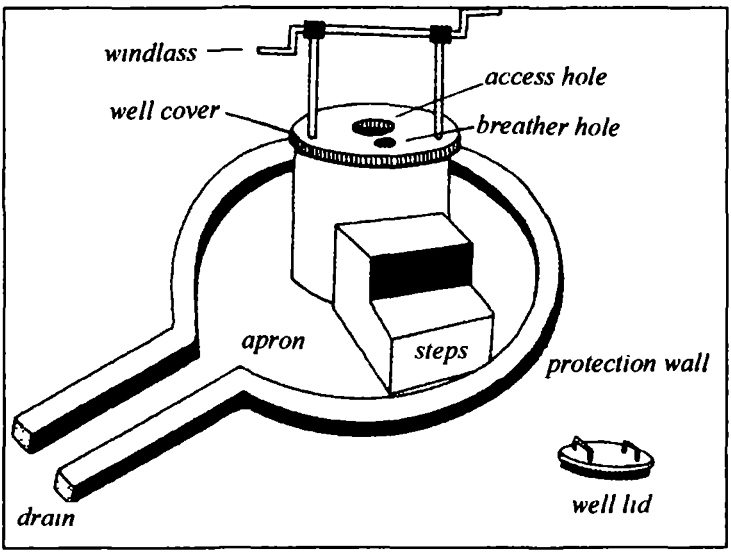

Figure 5.3 Layout of well head.

is lowered on ropes with the help of at least 15 men because of the weight. The concrete blocks are lowered one by one in a bucket and a cement and sand mortar (1:4) is used for the vertical joints and between the ring and the first course. In the horizontal joints between the first and second course and the second and third course, no mortar is used so that water can gain entry. One round of 3-mm galvanized wire is used with mortar between the third and fourth course, and a step made from a round iron bar is installed The same sequence continues until there are six horizontal joints without mortar through which water can enter. All subsequent joints are mortared. Steps are installed every three courses. After every six courses, the surrounding space in the well shaft is filled with coarse sand to act as a filter. The shaft is built 60 cm above ground level to prevent runoff from getting in, and barbed wire is left sticking out to join with the reinforcing in the apron that will be constructed around the well shaft to keep the area clean and prevent contamination.

The apron extends around the well shaft and slopes outward to a distance of 1.2 metres This area is first excavated and then back-filled with hardcore to a depth of 30 cm, to which is added a 5-cm layer of ballast A 5-cm layer of concrete (1.3:4 cement-sand-ballast) is laid on the surface, and barbed wire is placed concentrically and radially for reinforcing. A further 5 cm of concrete covers the reinforcing. The apron is surrounded by a low wall with a gap to allow spilt water to drain away. The work is completed by building two steps, each 30 cm high, to the well cover, plastering as necessary and placing the lid in position. Before the well can be used, the community must remove all the water and clean the bottom.

Sand dam wells

Sand dam wells are made in a manner similar to the school wells, but there are differences. First, they are rarely as deep as the school wells, usually less than 4 m. Second, they need to be built higher than the school wells to prevent river water from entering during peak flow. Sand dam wells are usually sited to one side of the river and some distance (10 to 20 m) upstream of the dam wall. Livestock may be allowed to drink from scoop-holes near the dam wall so that they do not pollute the surroundings of the well.

Abstracting water from wells

The simplest method of abstracting water is to use a rope and a bucket raised by hand, but the work can be made easier by using a windlass. Windlasses are fabricated locally and require little maintenance except for greasing the wooden bearings. The committee that manages the well has to make sure that the rope and bucket are kept clean and in good condition. Cleanliness is best maintained when everyone uses the same bucket for drawing the water.

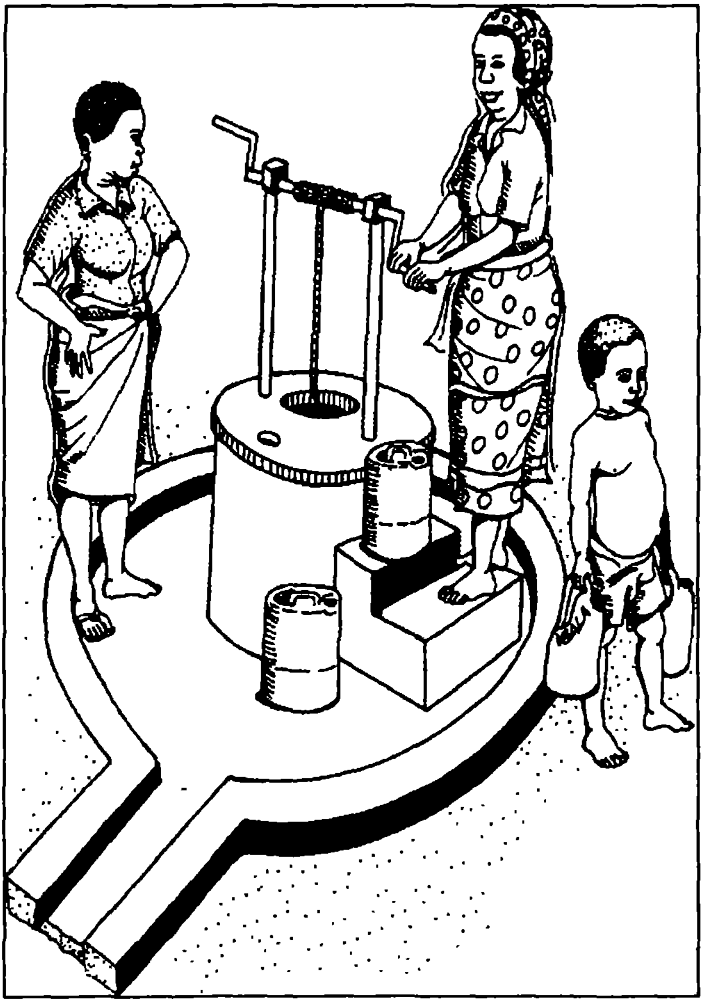

Figure 5.4 Drawing water from well with aid of windlass.

Hand pumps are a further step towards improving the quality of water but they have not yet been installed. There are several reasons for this First, a strong maintenance committee must be in place and the people responsible for the pump must have been trained on how to maintain it and have the necessary tools and spares to do so. Second, pumps are expensive items, and funds are not readily available. If outside funds are sought for pumps, the community may value them less and be less willing to maintain them than if they have had to find the money themselves.

Photo 9 Building the wall from river bank to centre

Photo 10. Constructing wall with rock filling

Chapter 6
Assessing the impact

The most innovative aspect of the SASOL project, and the one dealt with here, is the construction of sand dams which has impact on the community, on agriculture and on the environment. Although closely connected, these three themes are treated separately. However, for many aspects, quantitative data are lacking For example, the amount of sickness in the past that could be directly attributed to the shortage of water would be hard to ascertain. The people who are best able to evaluate the success or failure of a project are the people on the ground – the beneficiaries Therefore, this preliminary assessment is based more on the observations and comments of the local people than on other sources.

Impact on the community

The most immediate impact of the construction of a sand dam or a shallow well is improvement in the availability of water. In the past, people have had increasing difficulty extracting water from scoop-holes in the sand, both for their own use and for their animals, as the dry season progresses. As the water level drops, holes are dug deeper and deeper until there is risk that the sides of the hole will collapse and people or livestock be trapped.

Construction of sand dams impedes downstream flow and recharges the riverbanks, from which water returns as the dry season proceeds. This has the effect of maintaining a steady water level for longer.

If there is no sand dam, there are additional problems in times of drought due to the slow rate at which water infiltrates into the scoopholes. This can mean that women have to queue to get access to the water. In some situations, women have been forced to queue overnight and men have been assigned to protect them from possible attack by wild animals or thugs.

When the usual source of water dries up, people must go farther and farther afield to find a river where water is still available For example, the Nduni River regularly dried up before dams were constructed, forcing people to walk to the Kiindu River, much farther away. The time and energy employed in fetching water diverted attention from other tasks that could have been carried out in the dry season, such as terracing. It is not uncommon for women to spend three or more hours a day fetching water in the dry season.

When water becomes in short supply, girls are often withdrawn from school to help fetch it. This has serious implications for their education. The education of girls and women is reckoned to have a greater long-term impact in reducing population growth than any other single factor. It is therefore not unreasonable to argue that improving water resources will contribute to slowing the rate of population growth.

The impact of sand dams on health has already been recognized by some women but will be more noticeable as wells are constructed and the risk of pollution is reduced. When this is coupled with the wider adoption of pit latrines, boiling water for drinking and education on the causes of sickness, there will undoubtedly be significant improvements in health Furthermore, improvement in water supplies allows women to wash clothes in the dry season, a task that was difficult or impossible before

Apart from the direct impact of improving the supply of water, the project has an indirect impact on the morale of the community. First, the PRAs have enabled members of the community to take a look at their own situation in ways they have never done before It has encouraged people to think, to question, to analyze and to reflect. PRA has shown the importance of local knowledge and local observations. Through the PRAs, the communities have been able to assess their strengths and weaknesses and to plan together for measures that will improve their livelihood.

Second, the work of constructing sand dams and wells by the community with the help of an artisan has shown community members what they can do with the resources of labour and materials that they already have. It has shown them that they do not have to wait for someone else to take the initiative and that there is much that they can do themselves to improve their own situation, using their own tradition of co-operative work. This has the effect of empowering the people and especially the women, who have in the past borne the biggest burden of producing the food and maintaining the family.

Impact on agriculture

The impact of the project on agriculture takes several forms. In the first place, tree nurseries have been established close to the dams and wells so that seedlings are now available, or will soon be available, for transplanting around homesteads, along farm boundaries or in woodlots. The identification of the most useful trees during the PRA will ensure that trees that are useful and also well adapted to the area will be given priority.

In the second place, the time saved from fetching water is now available for terracing, which leads to the conservation of rainfall and improvement in producing the main food crops Terracing can make a major impact on food security if the land is maintained in good condition by the use of manure or compost and if the land preparation, planting and weeding are done well. By reducing the labour of water collection, more time can be spent on terracing and other farm activities.

Third, the production of vegetables in plots close to the river can provide income, especially in the dry season, and lead to improvements in nutrition.

Increased planting in riverbeds of sweet potato varieties that can be grown and harvested in the long dry season, from June to October, will also improve the supply of food

Finally, improvement in the supply of water will reduce the time that livestock spend trekking to water and the risk of disease associated with the trek It will also lead to improvement in the supply of forage due to the extensive planting of napier grass at the river edges.

Impact on the environment

Some of the impacts already mentioned such as planting trees, terracing, and growing vegetables and fodder grass close to the sand dams imply changes in the environment. But there are other more direct impacts. Raising the bed level of the river by installing dams reduces the erosion of the riverbanks and of the water courses leading into the river. Also, raising the water table encourages vegetation along the riverbanks and improves the stability of the banks. More information on this should come from the environmental studies currently under way. It is conceivable that retention of water in sand dams and the associated increase in vegetation and evapotranspiration will improve the microclimate and might even encourage rainfall – although there is no clear evidence on which to make assumptions. Certainly, improved water retention has encouraged the planting of napier grass alongside the riverbanks. Where both sides are planted in this way, the river is confined to the centre of the channel, but if only one side is planted, it may force the river towards the opposite side and lead to erosion of that bank.

The biggest question to answer is what is the impact on river flow? In what way will the installation of sand dams affect downstream users? Where there are 20 or 30 dams on a single river, will the people who rely on the lower dams find the flow of water adversely affected? And what will be the impact for the people who rely on the river yet farther downstream in the drier areas where there are, as yet, no sand dams?

Preliminary data seem to show that there is more water downstream than in the past as the overall flow is slowed Below the last Kiindu dam there were no scoop-holes Now there are – all year round.

It is likely that after a long dry season when much of the water in the sand dams had been extracted, a small rainstorm in the upper part of the catchment will recharge only the upper dams. However, where there is more general rainfall, the dams should be recharged by runoff from the adjacent areas as well as by water coming down the river from the upper part of the catchment.

No doubt, observations of the local people will answer many of these questions in time, but it will be important for future planning to have a systematic record of what changes take place in stream flow and water storage as a result of sand dam installation. The hydrological monitoring of ephemeral rivers is a difficult exercise, not least because the heaviest storms often occur at night and high flows that contribute much of the annual flow are of very short duration and hard to measure unless there is some form of measuring structure.

The design of many sand dams conforms more or less to the shape of a broad-crested weir, and as such it should be possible to get an approximate value for the peak flows by recording the depth of water above the weir crest. This may be observed from marks left by floodwaters on the side walls at either side of the centre spillway. More frequent measurements could be made with the aid of an open-ended vertical pipe installed just upstream of the wall and a measuring stick to determine the level of the water in the pipe. However, comparison with the original situation when there were no sand dams may be impossible, as few, if any, of the rivers have been monitored in the past Comments of people who have watched the rivers over many years will provide the best indication of the changes that have taken place

Experience from the Utooni project at Kola in Machakos District indicates that sand dams do not reduce the flow of water downstream. In that project, a horizontal pipe has been installed at a certain height in several dam walls to encourage a continuous flow The upstream end of the pipe is enclosed in a specially designed filter to prevent blockage.

It might be thought that sand dams would lead to flooding of land adjacent to the river and damage the crops. That this has not been a significant problem can be explained by the relatively steep gradient of the riverbeds. On a few sites, there is already evidence of lateral ground recharge as new water-demanding vegetation has appeared. These plants provide fodder for animals. Where wetlands are being created, there are new opportunities for growing specialized crops such as vegetables.

Sand dams not only provide storage for water, they also provide storage for sand. During times of flood, the lightest soil particles tend to be carried on down the river while the heaviest-the sand-are deposited wherever storage has been created. Sand is also a resource for building. In neighbouring Machakos District there has been widespread extraction of sand for building purposes, and as a result some riverbeds have been virtually cleaned out In such places, water is no longer available in the dry season. Although sand harvesting has not yet occurred in Kitui District or in the project area, to the same extent it is likely that there will be increasing demands for sand for building purposes. Provided that the community-based committees that manage and maintain the water supplies are strong enough, they should be able to control the removal of sand and minimize the impact on water storage.

One impact of installing a sand dam is that the energy of water that overtops the dam during a flood excavates the riverbed below the dam. The sand in the immediate vicinity gets carried further downstream and the rocks are exposed. It has proved necessary in some instances to construct a masonry footing at the base of the wall to prevent undermining.

Photo 11. Women discussing the project with visitors

Photo 12. Pastoralists from N Kenya assessing the potential of sand dams

Chapter 7

Looking to the future

Whatever changes may come to Kitui District, water will always be at the top of the development agenda, and the experience that SASOL has gained over the last five years will be valuable in charting the way ahead. The current programme is planned to cover an area of 200 km^2, to test the technologies in different soils and gradients and in different social structures. So far, funds are available for only 10% of this experimental area. There is need to finance the other 90%. Yet the district itself (excluding the area of Tsavo East National park) covers about 12,000 km^2. What are the possibilities for extending SASOL's approach to other parts of the district or to other districts with similar conditions and needs?

SASOL's approach is community based and therefore it is likely to succeed only where people have a tradition of working together to solve communal problems. Fortunately, this tradition is still strong in Kitui in spite of the trend towards individual ownership of land and the social differentiation arising from changing life styles. But in view of the out-migration of a large section of the able-bodied men in search of employment, communal work will be harder to organize in the lower and drier areas where population densities are less than 100 person per km^2.

Other factors, too, will limit the spread of wells and sand dams to the more arid areas. In such areas the water table is usually much lower or non-existent so that the cost of digging a well and the risk of failure is much greater than in the current area of operation. And as the slope of the land decreases, the river channels widen and meander, rock bars are less frequent and even where a good site can be found, the barrage is likely to be longer and more costly.

The same constraints are likely to be found in other districts with semi-arid or arid climate where the terrain is similar and the underlying rocks are of the ancient basement system.

Sand dams and shallow wells are likely to have greatest application in the transitional zone (agro-ecological zone 4) that lies between the sub-humid and the semi-arid zones and has a mean annual rainfall between 700 mm in the drier areas and 900 mm in the wetter areas. Here the population densities are generally between 100 and 300 per km^2. In this zone, the terrain is undulating, or hilly and river channels have steeper gradients than in the arid zone Rock bars are also more common.

In those small areas of Kitui District that receive more than 900 mm of rain on average, there are greater opportunities for tapping springs and streams for distribution of water. The water table is higher and shallow wells are feasible. Hence there is less need for sand dams.

One problem that does arise with increasing population and the expansion of small towns and trading centres is water pollution due to small industries and urban waste. The Kalundu River, which passes through Kitui town, is not included in SASOL's sand dam programme for this reason Clearly, improving water supplies has to go hand in hand with education on environmental issues and especially pollution.

A shallow well adjacent to a sand dam will improve the quality of water by filtering out dirt, but people who are accustomed to scooping water from the sand may not see the need for change. Education on health and hygiene will continue to be important adjuncts to any programme of water development.

The rights to water will also need to be clarified. If a sand dam is constructed, can those who have land upstream and adjacent to the river take water out by pumping to irrigate their vegetables? And what control exists over those who might want to extract sand for building purposes? Clearly there is a role for water-user committees or village committees in ensuring that the benefits of water development are equitably shared.

Box 7.1. Logical framework projections, 1997-1999·
Key indicators of success

* 65 new sub-surface and sand dams on ephemeral rivers
* 35-50 off-take wells
* 28 water catchment CBOs formed and functioning
* 1 new water storage technology (subsurface and sand dams) tested and implemented
* 25% of households in project area aware of the need for catchment management
* 25% of households in project area aware of the need for water hygiene and of the illnesses related to the lack of water management

One of the attractive features of the SASOL sand dam programme is that labour is provided voluntarily and most of the materials required, the sand and stones, are available locally at no cost other than the labour of collection. Funding is required only for cement, reinforcing and the employment of an artisan (box 5.1). Once construction is complete, there should be little or no maintenance. This kind of development can therefore be easily replicated. Already a few individuals are beginning to build small dams on their land. However, success depends on the employment of skilled and experienced masons who maintain a high standard of workmanship. There is also a need for engineering advice in difficult situations.

One of the lessons that SASOL has learned is the value of the participatory approach to development. The task at hand is not simply to install wells and dams but to strengthen communities to take advantage of the opportunities that exist and to cope with the problems that arise. The participatory approach draws on the knowledge and the experience that already exist within the community and enhances the ability of its members to deal with the challenges of development, as far as possible, from their own resources.

Although SASOL's prime focus is to develop water supplies, the need to improve the production of food and reduce the risk of famine and disease cannot be overlooked (box 7.1). Holding rain where it falls through terracing and establishing trees, and improving soil fertility through better preparation and handling of manure and compost are some of the activities that should be encouraged. SASOL has established close links with many communities through water development and could use those links as a channel for agricultural extension. This would be a valuable contribution to development in view of the financial restrictions placed on government extension staff

With the population in Kitui District still growing rapidly, priority has to be given to increasing the availability of water and to producing food. Thanks to the technical and financial support from WaterAid, World Neighbours, DFID and Sida, SASOL been able to point the way forward. However, nothing could have been achieved without the voluntary labour of large numbers of local people, toiling and sweating under the sun.

The story is still unfolding, but what has been done gives hope for the future.

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Photo 13. SASOL team reviewing the progress
Left to right: David Kithuku, Cyrus Mutiso, Sam Mutiso

22 October 1999

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Dear Sir/Madam

Please find enclosed a copy of a recent publication by one of WaterAid's former partner's in Kenya, Maji na Ufanisi (Water and Development).

Maji na Ufanisi and SASOL (Sahelian Solutions Foundation) collaborated jointly on the development of the 'Where there is no water' booklet. It seeks to underscore the vital role of water for increased productivity in the Arid and Semi Arid Lands (ASALs).

Please contact Maji na Ufanisi directly if you require further copies.

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Yours sincerely

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Water is the key to development in semi-arid and arid lands, yet making it available and accessible is a major undertaking. This booklet describes one approach that has been developed successfully in a low rainfall area of Eastern Africa.

The story is located in Kitui District, Kenya. It describes how communities have been enabled, through participatory training, to evaluate the resources available, to analyze the problems they face and to develop strategies for development of water supplies.

The aim has been to create a network of sources so that no one need walk more than two kilometres to fetch water. The network includes tanks for harvesting rainwater, shallow wells adjacent to schools and sand storage dams in dry river beds. More than 100 sand dams have been installed through a community based programme initiated by SASOL (Sahelian Solutions Foundation). The procedures for mobilization of communities and construction of sand dams are described and the impact assessed.

Development of water resources has implications for the production of food and fuelwood, for health and for education, especially of girls who may be taken out of school to fetch water in times of drought. Issues raised include the environmental impact of sand dams, the quality of water and the establishment of community based systems for long-term management of the resources.

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