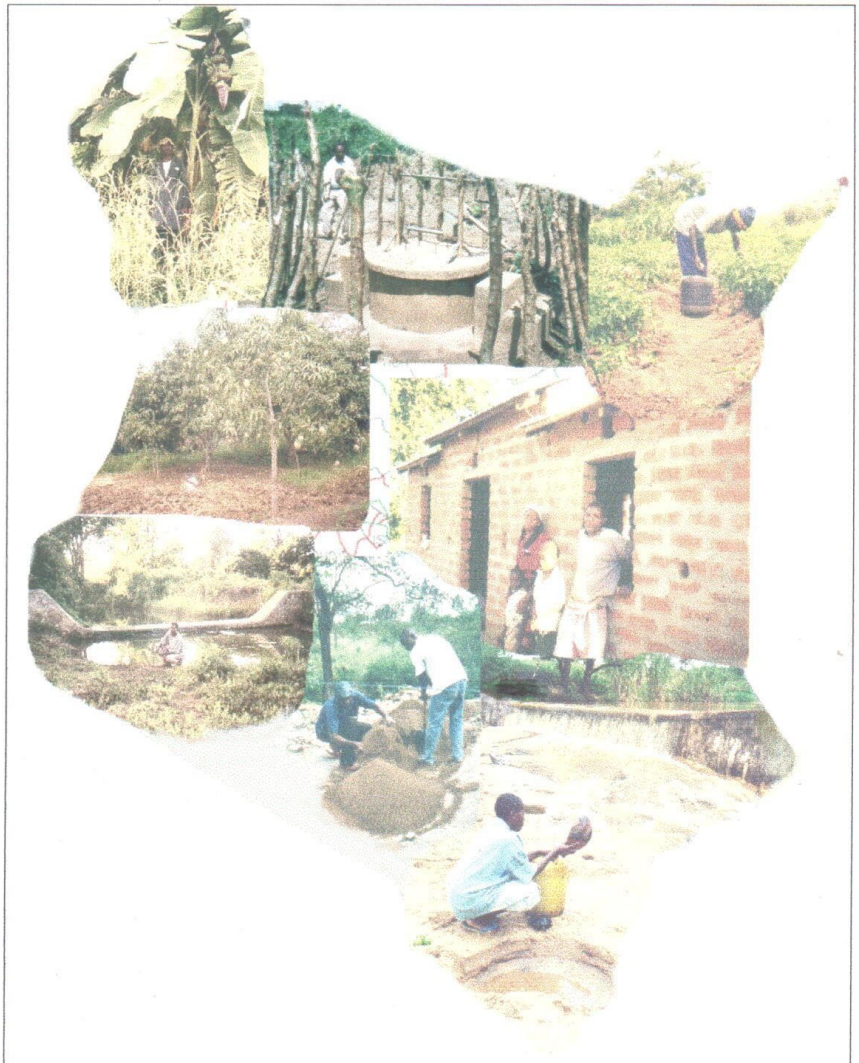
KITUI SAND DAMS:
SOCIAL AND ECONOMIC IMPACTS



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WATER

Water's far from a simple commodity,
Water's a sociological oddity,
Water's a pasture for science to forage in,
Water's a mark of our dubious origin,
Water's a link with a distant futurity,
Water's a symbol of spiritual purity,
Water is politics, water's religion,
Water is just anyone's pigeon,
Water is frightening, water's endearing,
Water's a lot more than mere engineering,
Water is tragical (sic), water is comical,
Water is far from the pure economical,
So studies of water, though free from aridity,
Are apt to produce a good deal of turbidity

Kenneth Boulding,
Catholic University· Leuven
Belgium 2001

ACKNOWLEDGEMENTS

SASOL did not have the funds to undertake a comprehensive baseline study before beginning the sand dam project. Rapid Rural Appraisal techniques were used to identify the project. The initial donor -Water Aid- was comfortable with this approach. Water Aid funded five dams on experimental basis. It was on the basis of reviewing the experience of the first five dams that DFID funded the next thirty. Since 1995, SASOL has implemented the Sand Dam Project in Kitui with funding from Water Aid, DFID, SIDA and Canadian Food Grains Bank.

DFID has funded this study for two purposes. First is to provide baseline data for the much drier, less populated, more food insecure and generally poorer area of Kitui district comprising of Yatta and Mutomo Divisions, where SASOL intends to start operating. Secondly, the study would identify lessons learned in the more densely populated areas of Central Kitui.

We would first like to thank DFID for funding this study. It is not easy for people of Kitui to welcome strangers asking a lot of personal questions into their homes. We thank our six thousand respondents for welcoming the enumerators and supervisors to their homes and taking the time to answer questions, which at times did not make sense to them as some told us.

Special thanks go to our research assistants who fell into ditches, walked for miles on end without water or soda and generally did a fantastic job in the middle of a very dry and hot period. They are Eric Musyoki, Joseph Munguti, Winfred Kongu, Benjamin Mutuku, Mueni Mulei, Salesius Mwanzia, Hilda Manzi, Risper Kavula, Mercy Mulevu, Joseph Munyoki, Nduto Musyula, Onesmus Mwangangi, Munywoki Kali, Esther Mueni, Mwende Kyali, Naomi Kithome, Kalunde Mulei, Jacqueline Munanie, Patrick Nyamai, Peninah Malonza, Patrick Mutati, Judith Mwende, Amos Wambua, Alex Mbuta, Mr. Musingila and Rose Mulaimu. We would like to most sincerely acknowledge the effort made by this team in data collection, coding and entry.

We are indebted to Sam Mutiso, SASOL Field Manager for his support during the fieldwork. His commitment was instrumental in ensuring the progress of this study. It is our hope that the knowledge gleaned from this work will help him and his team in implementing the exciting project in the more problematic parts of the district.

Mutua Isika supervised the fieldwork, data coding and processing. Milu Muyanga was involved in data processing. Both had taken part in the design of the study including field-testing of the questionnaire. Both were responsible for drafting the report. Prof. G-C .M. Mutiso edited it.

June 2002
Nairobi

GLOSSARY

A.A.S	Africa Academy of Sciences
ASAL(s)	Arid and semi arid land(s)
Asomi	The elite
CBS	Central Bureau of Statistics
DANIDA	Danish International Development Agency
Division	An administrative unit in a District
GOK	Government of Kenya
Harambee	Pull resources together
Ianzo (singular for *Maanzo*)	A previously settled place
IFPRI	International Food Policy Research Institute
IRC	International Water and Sanitation Centre
Isyo	Kamba food staple-usually a mixture of maize and beans.
Isyuko (plural *Masyuko*)	Cattle watering point
Itiko (Plural- *Matiko*)	Fertile farming land with inland drainage
IWSS	Improved Water Supply System
Kathambi	Akamba female water goddess
KIDP	Kitui Integrated Development Programme
Kiondos	Akamba traditional hand-woven baskets
Kithaayo (Plural-*Ithaayo*)	Salty ground (Salt-lick)
Kuvuka	To scoop water from the sand
Kyanda	A swampy farm land
Location	An administrative unit in a Division
Misonzo (singular- *Musonzo*)	Uncultivated strip of land sometimes stacked with cowpeas and maize stalks to slow cultivated land erosion
Mongu	Cucurbit Species
Mung'eeto (Plural- *Ming'eeto*)	Local name for a sand dam(s)
Musyi (Plural- *Misyi*)	Homestead(s)
Myethya	Self help Group or party
SASOL	Sahelian Solutions Foundation.
Shamba	Garden
Sub-location	An administrative unit in a location
Sukuma wiki	Kiswahili name for Kales
Syengo (Singular *Kyengo*)	Cattle posts
Ndania	Coriander
NGO	Non-Governmental Organization
Ngolano	Akamba traditional ultimate socio-political control institution
Uki wa Kithio (*Kaluvu or Njoma)*	Types of locally brewed beer
UNICEF	United Nations Children's Fund
Weu	Communal grazing lands where cattle posts were established
WMS	Welfare Monitoring Survey
Yua	Famine

EXECUTIVE SUMMARY AND RECOMMENDATIONS

Kenya is among a group of countries faced with inadequate renewable resources, a problem acute in arid and semi-arid parts and compounded by weak development institutional arrangements. Only 45% of Kenyans have access to clean water. Note that clean water does not designate portable water. Studies show that communities living in arid and semi arid lands have limitations in accessing sources of water.

This study explores the Social and Economic Impacts of the sand dams. The story of sand dams in Kitui is an example of positive reaction to drought caused misery and distress. Since 1995, women and men in Kitui District have taken actions to assure their survival. This community has proved less conservative and more adaptive to change than is usually thought. Men are accepting less dominant roles in project implementation. The community has begun to plan and implement its development. There is nothing to hold them back and nothing seems to be too difficult to them.

The success of the sand dam project in Kitui is based on community participation, which is strongly rooted in greater understanding of the differences and overlaps between male and female roles and responsibilities. The fact that almost all women involved are housewives suggests that their new roles are accepted and supported by the male members of their respective households and the community at large. That they are the main participants in the project does not increase their labour load for provision of water reduces the time they spend fetching it. This was the main objective of the project.

The study draws data from sampled households of both participants and non-participants in the project and baseline areas. A representative number of households (10% of the total number of households) were sampled using stratified random sampling technique using the households' populations figures obtained from the 1999 National Census was used. For the purpose of obtaining a comprehensive picture of social and economic impacts of the sand dams, inter-method triangulation (application of both qualitative and quantitative methods in data collection) approach was adopted in interpreting the data from many disciplines, especially in Chapter 2 on Background and Theoretical Perspectives and conceptualising the quantitative data found in Chapters 7,8,9 and 10. In this later part of the study, the quantitative interview data analysis was limited to frequency table analysis, correlation tests as well as simple econometric regression analysis. These yielded both simple, easy to understand descriptive and inferential statistics used in making predictions and conclusions necessary to answer the study questions. This way of organising the first report was adopted to give the authors a way of presenting complex historical and current data. The second report is composed of data summaries on sub locational basis. This data was needed by SASOL as specific record on each sub location to be used in the future. It is particularly relevant in the areas not yet involved in the project for it forms baseline data.

The results from the study indicate that after the sand dam project, distance to the water sources, water quantities and quality, depth of scoop holes during the dry season improved. Cost of water also reduced as scoop holes infiltration rates and distances to water sources improved and reduced respectively. Increased economic activity driven by availability of water is noted. There is extensive introduction of new crops and activities. Perhaps most significant impact is the reduction in time and labour spent on water fetching chores. It is this saved labour that is now

applied in assuring food security for the people of Kitui clearly understand that the key development constraints are water for production and food insecurity.

This study established that the sand dam technology is suitable in socio-economic terms for provision of water in Arid and Semi Arid Lands (ASALs). It is easy to construct, operate and cheap to maintain. Its maintenance and operational needs meets the local expertise and resource endowment. There is need for in-depth studies aimed at coming up with suitable technologies for black cotton soil areas. Other development partners are encouraged to replicate this technology in other ASALs.

However, the following recommendation should be taken into consideration. Training should be enhanced to cover more participants so as to impart greater sense of care and willingness to maintain the sand dams as well as addressing new needs. This calls for a stand-alone project on training for sustainable development for there are at least 20 NGOs with their own committees working in the same areas SASOL is working.

It must be noted that some of the areas covered in the training are not new to the communities. Communities have been sensitised on them. For example, almost everybody knows the dangers of drinking unboiled water, yet half of the respondents do not boil drinking water! This poses a new challenge to trainers to cultivate new and more palatable approaches in addressing these issues to beef-up retention and practice.

There is need for SASOL and other development partners in water sector to address the physical and bacteriological quality of water in the already built up area. The issue of water pumping facilities for domestic and production purposes should be addressed in the long term.

The participatory nature in the approach of the sand dam project is laudable. This encourages ownership and control of development projects by the locals. It also checks chances of privatisation of dams. Cases of wealthier community members volunteering to provide almost the entire requirements must continue to be discouraged.

Low frequency of the dam committee meetings was reported. Indefinite tenure in office was reported too. This limits the scaling-up effects of the training imparted on them (dam committee members). It is important to beef-up the frequency of the committee meetings to possibly four to six times in a year. The duration in office of the committee members must be limited to two years to give other community members a chance to lead.

The committee members should be trained on data collection and bookkeeping if they are to become useful in other activities like marketing of vegetables grown with the sand dam water. This will enable them to monitor market trends to help the communities in arriving at relevant technologies and optimum production levels.

Communities must be sensitised of the changed Government's role in the development process. Communities should no longer wait for the Government or other development partners to initiate or take lead in local development projects. If this mentality persists, (belief that the responsibility of tackling poverty lies in the hands of the Government) poverty levels will remain high.

As water quantities increase chances of pollution are increased. Cases of people bathing or washing clothes near the source using detergents, potential pollutants, where reported. It was also established that almost half of the households do not have toilets.

Local communities must continue to be urged to increase soil conservation practices on catchment basis to maximise positive effects. These include terracing, tree and grass planting, etc.

The need to intensify the planting of Napier grass along riverbanks must be emphasized for it is an effective fodder crop and it enables individuals to deepen or re-enter livestock production. The potential for keeping hybrid livestock exist. This can make the project area one of the major sources of milk in the district.

Specific decision-making training and action oriented planning for development and community emergencies should be undertaken. In some cases the control of family resources is bestowed on individuals working outside the village. This causes delay in community projects implementation and low participation levels.

The communities must be imparted with skills on how to tap the created opportunities and how to cope with new challenges after the project. Cases of farmers loosing their entire crop of vegetables to pests and diseases were also reported. It must be noted that these farmers are venturing into new practices that they know very little about. Farmers should be taught how to handle the challenges. This might require external expertise. It is recommended that some farmers should be equipped with these skills in each catchment. This will have a strong positive externality effects and with time scale-up to cover the entire community.

Some respondents were found not to be ready to take any form of action if they found anybody polluting or damaging their water source. This points out to the need to train the communities and to expose them to the various avenues of the law were they could seek redress if wronged as an individual or as a community.

For the purpose of comprehensive management of water resources, catchment committees should be formed. This will ensure that water is managed in a wider scale to avoid efforts of one group being destroyed by another one. Water quality, soil erosion, catchment vegetation cover, will be more effective and rewarding if it is managed from a catchment level. Using these committees, it is possible to prevent deforestation and overexploitation of forests.

Local communities must be encouraged to come up with local development plans listing their development priorities and possible local solutions. This will save the development partners enormous resources, which they use in trying to identify community needs and how best to tackle them. This problem needs tackling at the wider development partner cooperation level.

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1.0 INTRODUCTION AND OBJECTIVES OF THE STUDY

1.1 INTRODUCTION

Kenya is among a group of countries faced with inadequate renewable resource base, a problem acute in arid and semi-arid parts and compounded by weak development institutional arrangements. Only 45% of Kenyans have access to clean water. Note that clean water does not designate portable water. Generally, households living in the medium and high potential parts of the country are considered to have access to safe water if they can get 20 litres of clean drinking water daily from sources within a kilometre away (Kimuyu, 1998). Studies show that communities living in arid and semi arid lands have limitations in accessing sources of water. They use open water sources, more prone to contamination. Closeness to a source of water, quality and quantity are important considerations in choosing technologies for providing and conserving water. At the global level, statistics show that 1.3 people do not have access to safe water, 800 million are malnourished and hunger is their constant companion (A.A.S[1] et al, 2002). Currently, over 26 African countries, including Kenya, have more people than their water supplies can adequately support (A.A.S et al, ibid).

Most governments in developing countries are shifting their governance and development roles from 'providers' to 'facilitators'. This has been necessitated by contracting resources base, and failure of 'top down' (one size fits all) approach to development. This shift is placing more emphasis on water resources management at the lowest appropriate level. It calls for the empowerment of the users and interaction between the users, non-governmental organizations, the private sector and the local government.

Major weaknesses and gaps preventing communities from benefiting from their water supply systems have been reported (IRC, 1995). These include insufficient capacity building; partial coverage of user populations; lack of effective and equitable financing systems; absence of suitable management tools; environmental degradation of watersheds; and absence of proper gender balance in planning for, contributions to and control over the established water service.

Much can be achieved by building on experiences with locally developed management patterns for traditional water sources. Water collection and uses are often regulated by explicit agreements (IRC, 1995). Women, who have for a long time played a crucial role in the traditional society, make many of these agreements. They have been managing water resources and have proven capable of taking responsibility for complex technologies, as well as managing basic care of water points. Women and men can play decisive and indispensable roles in ensuring the success of water improvement programmes, when neither party is overburdened or excluded and when work; authority and training are divided in a balanced way.

In semi-arid and arid Africa, water often dictates the orientation of habitations, and it always conditions human existence wherever the scarcity or lateness of rains endangers means of subsistence. We thus can understand the immerse role which is/was traditionally played by the personage commonly called the "rainmaker" (Zahan, 1970) or the intermediaries to the rain-making forces-usually women..

[1] African Academy of Sciences

1.2 OBJECTIVES AND THE SCOPE OF THE STUDY

1.2.1 Main Objective

The main objective of the study is to systematically establish whether the project has had social and economic impact in terms of: -

A. Increased land output through sustainable agriculture based on optimal use of local resources and natural processes and safe efficient use of external inputs;

B. Empowerment of local communities who seek to build their future on basis of their own knowledge, skills, value, culture and institutions; and

C. Impacting on production leading to changes in the standards of living of the local inhabitants.

1.2.2 Secondary Objectives

The secondary objectives are *inter alia:*

1) Establish whether there exists trade-off between agriculture and livestock production in the period before and after the construction of the dams.

2) Establish how the time and energy saved from reduced water distances is utilized.

3) Assess how the increased incomes accruing from increased land output impact on the stability of the family unit (especially the youth) and the welfare of the women and children in the project area.

4) Establish how the communities constitute and balance gender and social stratification in the dam committees; and the attitude of the community members towards the management style and sustainability of the dams.

5) Investigate whether the created production opportunities act as incentives to attract people living outside the project area to either acquire or lease land for strategic reasons.

6) Identify whether there is organizational, production and social scaling up including influencing policy at the micro, meso and macro level.

1.3 JUSTIFICATION OF THE STUDY

While many resources are invested in water projects in developing countries, rarely are these investments subjected to serious social and economic analysis. A review of the existing literature on the economic and social benefits of improved water supply systems surprisingly shows that little empirical work has been done. The challenges prompted by changing economic, social and physical realities, call for more attention to be paid to empirical socio-economic analysis of improved water supply systems to enable intelligent decision making on technologies, levels of

service and uses. This will ensure that the limited resources available for water development are utilised in the best way.

Improving water supplies must be informed by demand for personal use and production. A water supply development strategy without multiplier effects is meaningless and more so irrelevant in this era of poverty eradication in Africa. Provision of water has great externalities (spill-over effects) compared to other resources. Most production limitations faced by inhabitants of the project area stem from water scarcity.

Further, it is important to get policy lessons out of actual water supply improvement projects given the resources committed by local communities and development partners. Study of the social and economic impacts of the project results will be of paramount importance in determining the viability and replicability of similar projects elsewhere in arid and semi-arid areas. It is only by deriving policy guidelines and practices out of specific Kenyan data that meaningful contribution to the fight against poverty can be achieved.

2.0 BACKGROUND AND THEORETICAL PERSPECTIVES

2.1 THE SAND DAMS OF KITUI

In Kitui District, construction of sand dams has brought about a unique dimension in the whole water development process in the area. This is because the applied technology is simple and lends itself to participatory development methodologies. To date over 320 (2002) sand dams have been constructed by communities living in the central parts of Kitui district by SASOL. Globally, this is the highest concentration of sand dams constructed anywhere in the world. An example of a modern sand dam is found in photograph 1 below.

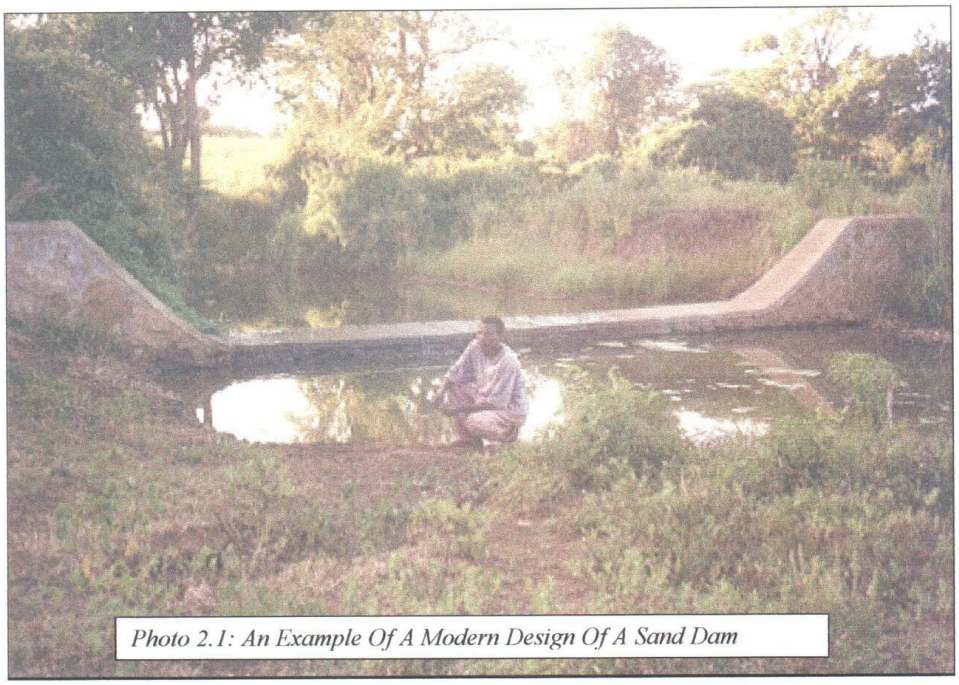


Photo 2.1: An Example Of A Modern Design Of A Sand Dam

Sand dams are not new in the district (See *Mung'eeto wa kwa Nzamba* in Photo 2 below). The first sand dam in Kitui was constructed during the colonial period in 1920's. Others were constructed in the 50's and most of them are still in existence. This technology has gone through the most severe test of all- time. In the past, 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. It could also be used to refer to an impervious underground barrier in a low-lying area that prevents the lateral flow of ground water thereby maintaining or raising the water table. In contrast, a sand dam is a barrier on an ephemeral river. Although the upper side of the wall may be hidden by sand, the lower side is usually exposed, either due to excavation by water when the river is flowing or by design. The geology of an area determines whether the sand dam technology can be used for water provision.

Geologically, Ukambani, like the rest of East Africa, came into existence some twenty-three million years ago during the Cainozoic era or precisely in the Miocene epoch of tertiary geological development. Because of this, the whole of eastern Kenya, up to Somalia, is lined with marine Jurassic and volcanic beds. Several studies (Ojany, 1968; Ominde, 1971) have revealed that the region was an active volcanic zone, and such activity was responsible for various volcanic and fault features in the region. The geology of Kitui, for example, is characterised by metamorphic and igneous rocks of the basement complex system. Its southern part is composed of perminian deposits while tertiary volcanic rocks that extend into Machakos District dominate the western side.

Three main catchments were chosen for much more detailed comment within the overall study and are categorized according to their geological characteristics. The characteristics depend on the topography of the riverbed. The detailed part of the study was carried out in the Central and Chuluni divisions of Kitui district where SASOL Foundation has build sand dams. The main rivers studied were Kiindu, Kisiio and Mwiiwe (and their tributaries). These rivers were divided into catchments depending on the general characteristics of the landscape and geomorphology.

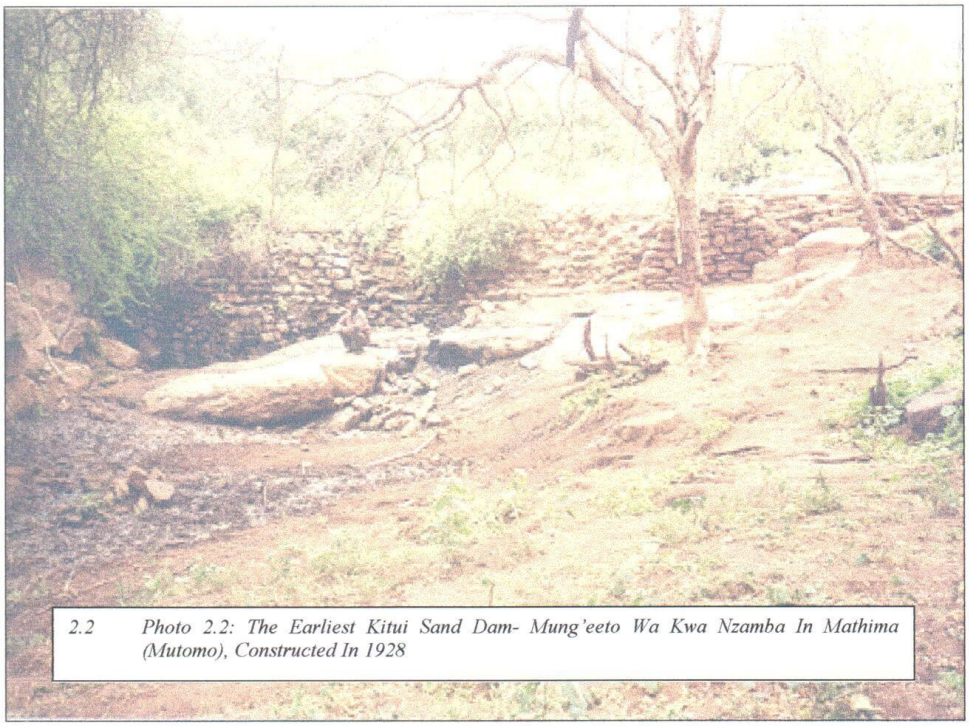
The soil type and the geological structure of the project area are very important because they determine the size of the dam and have a bearing on the economic activities to be carried out near the dam. While locating dams, SASOL staff and the community members have to balance the two aspects. The issue has proved to be very tricky. In some cases, it happens that the community interests are in conflict with the required geological conditions for a sand dam. For example, the community members may settle for a site, which is central and thus convenient for most households, a site with fertile flood plains (a necessary condition for agriculture), or a site, which is good for watering animals (*Isyuko*). On the other hand, SASOL's technical staff may disagree with the site owing to its geological structure. For example some chosen sites may lack the necessary conditions for a strong foundation for the dam -a porous rock structure. At other times, the community identified sites may be too steep to allow the river to deposit sand, too steep to allow the river to back-up or too fast flowing for the safety of the dam. Cases of community members choosing salty sites *(Ithaayo)* have also been reported (Mutiso and Kithuku, 2001)[2].

SASOL staff has to explain to the community members the site they have identified for the dam is not the best. Care has to be taken to avoid misunderstanding between the two parties.

2.2 KITUI DISTRICT IN PERSPECTIVE

Kitui district is located in Kenya's Eastern Province. This district extends for roughly 200 km from north to south and 120 km from east to west. It borders Machakos and Makueni Districts to the west, Mwingi District to the north, Tana River to the east and Taita Taveta to the south. It is located on between latitudes 0"7' and 3"0' south and longitudes 37"45' and 39"0' east. It covers an area of approximately 20,555.74 km^2 including 6369.1 km^2 occupied by the uninhabited Tsavo National Park.

[2] Mutiso, S and Kithuku, D. (2001) Personal Communication



2.2 *Photo 2.2: The Earliest Kitui Sand Dam- Mung'eeto Wa Kwa Nzamba In Mathima (Mutomo), Constructed In 1928*

The district is classified as one of the arid and semi-arid lands of Kenya (Woodhead, 1989). Different physical features dictate the distribution of rain. The hilly parts of central and eastern i.e. around Kitui town and Mutitu hills receive 510- 1015 mm of rain per annum. In this zone, Mulango, Nzambani, Kisasi, Miambani, Kyangwithya and Matinyani locations (note that this refers to the old administrative locations) receive between 760 and 1015 mm. of rain annually. Endau and Makongo hills, to the extreme eastern part of the district, also receive between 510 and 1015 mm of rain per annum. No recording exists for Mutha, Mutomo and Kanziku hills in the southern part of the district. The rest of the district receives between 225-510 mm of rain per year (Kisovi, 1989). Lack of water is therefore a perennial story in most parts of the district. The climate is hot and dry for most part of the year and is characterized by high rate of evaporation. A combination of high evaporation rates and unreliable rains (less than 1000 mm) limits intensive and meaningful land use and other related development activities.

In 1962, Kitui District was a part of the then Southern Province of Kenya. Its population was 191,023 people. To arrive at this figure, the population of locations in the Northern Division amounting 93,636 is netted out. The population of Mui [5,837] and Nuu [7,509], locations of Eastern Division, is subtracted. Mui and Nuu locations are in the current Mwingi District.

In 1969, the Kitui population stood at 214,406. The population of Northern Division [135,689], less that of Mutonguni Location [25,585], is netted out. The population of Mui [7,204] and Nuu [8,072], locations of Eastern Division, is subtracted. Mutonguni Location is in Kitui while Mui and Nuu are in Mwingi District.

Box 1: THE DEMOGRAPHIC TIME BOMB[3]

1. INTRODUCTION

At the centre of any alternative framework in development is the human dimension. Population growth and spatial distribution in a region is an important pointer for guiding the direction upon which the development strategy should focus. In many development agenda, however, this important human element is either omitted or less vigorously addressed.

Since development is brought about by man and woman, it is on him and her that us all, Government, Non-Governmental Organizations, Development agencies, should focus our effort. The ultimate purpose of development is to improve the basic social services and generally raise the quality of life in a given community. We cannot, however, attain this objective without an understanding of where the people live, their numbers, their problems and priorities, their history, their perceptions and many other socio-economic aspects.

Kitui District is one of the arid and semi-arid regions of Kenya whose high population growth threatens the future development of the area. Its deteriorating population-resource balance is set against a limited resource base and a demographically explosive growth rate. The total population in the district increased seven times between 1910 and 1989. The population growth rate jumped from 1.7% in 1932 to about 3.8% in 1989. As a result of this rapid growth, population pressure is now a major threat to agricultural productivity in the district. Like in many other rangelands of Kenya, signs of physical environmental stress and deterioration in human conditions are already evident throughout the district. Among them are land fragmentation, migrations to the more arid areas, increased soil erosion, declining crop yields and a swelling flow of urban-bound migrants.

This box presents the demographic trends in Kitui District. It is divided into four parts. Part one traces the historical migrations and settlement of the Akamba people in Kitui district. Part two presents the demographic characteristics. In this section population growth is examined from the pre-colonial period to the present. Part three discusses population pressure and some of the major consequences of rapid population growth rates in the area. The last part presents a summary and the recommendations bearing on policy implications. All this information is considered necessary because it forms a strong base upon which more informed decisions should be built if sustainable development in Kitui district is going to be achieved.

2. MIGRATIONS AND SETTLEMENT

Theories state that the Akamba migrated to their present settlements by branching off, into Kenya, from a group of Bantus who were moving north-eastwards along the coast of the East African region from the Shaba region of Zaire during the early fourteenth century (Ogot, 1968; Murdock, 1959; Soper, 1967; Guthrie, 1962). Archaeological evidence for the Bantu Iron age agrees well with this linguistic proposal. The distribution of "channel dimple-based" pots from the Zambezi River, which date from the beginning of the first millennium, has generally supported an eastern and northward expansion of Bantus from Zaire (Murdock, 1959:106). Soper (1967) has also revealed an iron age Bantu culture, known as the Kwale culture, extending from the hinterland of Mombasa to Pare mountains, and Mount Kilimanjaro.

Gregory (1896) holds the view that the Akamba originated from the south of Mount Kilimanjaro. Fedders (1979) makes a similar argument when he states that:

> **"...with an exception of a small group (The Mumoni) all Akamba agree in their oral tradition that the plains around Mount Kilimanjaro were the earliest known region for them — during the sixteenth century the Akamba dwelt in the plains "Nthi" around "Kiima Kyeu", the white mountain (Fedders, 1979:113).**

The white mountain mentioned here by Fedders (1979), which is also indicated in more recent research by O'Leary (1984), is believed to be the snow-covered peak of Mount Kilimanjaro.

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Oral tradition suggests that the Akamba arrived in the area of Machakos during the fifteenth century when through migratory drift they left Kilimanjaro plains for the Kyulu (Chulu) hills where water proved insufficient. Migrating across Kibwezi plains, settlements were finally established in the seventeenth century. Scholars have long suggested that the initial Akamba settlements in the hills were for protection against the Maasai, however recent investigation of both Maasai and Akamba oral traditions casts doubt on these early interpretations (Jackson, 1976:191). More likely fertile soils and reliable water supply provided the prime inducement for the emergence of prosperous rain-fed agricultural settlements in the seventeenth century.

It was in Mbooni hills that the social character of the Akamba developed and where the primary institutions of the Akamba society emerged. Through the creation of terraces and simple dams, the Akamba society adjusted to their highland environment. From Mbooni families migrated to neighbouring hills such as Kilungu, Mbitini, Kalama, Iveti and Kanzalu. These hill lands of Machakos became known as IULU, to be later corrupted as "Ulu" in colonial geography. Subsequent population growth and increasing denudation of the hill tops resulted in erosion such that by the beginning of the eighteenth century small groups migrated from Mbooni hills, crossed the Athi River and established the Akamba settlements in the central hills of Kitui and at Miusyani in Ikutha (Map 1). Lindblom (1920) dates the crossing of the Athi River into Kitui at about 1715 A.D. About 1740 A.D larger groups followed into Kitui and movements continued until 1780 A.D (Lindblom, 1920:162).

Once in Kitui the Akamba continued to migrate. From Miusyani they moved to the hill complexes of Ikutha, Kanziko, Mutha, and Inyuu, eventually reaching the central block of mountains in Kitui Central and into Mutito hill about 1800 A.D. From there migrations went south-eastwards towards Zombe. At Zombe, one migratory path went towards Makongo mountain and from there to Endau mountain, another edged southwards towards Mutha and Kanziko where there were already Akamba settlements already.

Another migratory route from the central block of Kitui mountains went northwards through Mutonguni and Migwani hill ranges reaching as far as the hills which surround Mwingi at about (1820 A.D). At Mwingi one migratory route continued northwards reaching the Mumoni range at about (1850 A.D); the other followed the Enziu River eastwards. At Nguni this path split. One route moved northwards reaching the Nthunguthu complex of hills (Mai), Ngomeni, and Tolotwa outcrop about 1860 A.D. The other wave turned southwards towards the hill complexes of Imba and Ukasi (O'Leary, 1984:19).

The continued population growth forced people from the better-watered hill lands into the more arid and drought prone plains. This migration to adjust to population pressure was stopped at the beginning of the twentieth century by the imposition of the colonial system and ancillary differentiation in society (Mutiso, 1977:11; Munro, 1975; 125). It is evident that at the advent of the colonial period, there were only three main isolated pockets of population concentration in Kitui District, that is the Central Hills, the Southern block of hills at Mutha, Kanziku and Ikutha, and the Northern range of hills at Mumoni. Another isolated pocket of population settlement was around the hills at Engamba in Eastern Kitui.

The history of the Akamba from the eighteenth century is replete with accounts of devastating droughts and famine. Historically the Akamba coped with the vagaries of their environment through a variety of traditional mechanisms. Hunting, gathering, and trade became viable options for survival. Out-migration from the devastated areas was an option in an area where land was an abundant resource. Raiding became common in times of extreme stress. It is apparent that these traditional mechanisms of coping with drought and hardship are no longer viable alternatives, yet drought and famine remain a persistently recurring problem.

Colonial domination of Ukambani began in the nineteenth century and resulted in the Akamba being confined to "native reserves". Continuing population pressure within the Kitui native reserve forced the Akamba into the more arid, marginal lands and the ensuing population and livestock pressure caused severe environmental deterioration. The colonial government undertook vigorously forced soil conservation programmes in the 1950's, which were partially successful. Attempts to control the number of livestock, however, met with total failure. With the advent of independence much of the work undertaken by the colonial government in soil conservation was abandoned and once again environmental deterioration became an ever-increasing problem as the population had grown and even more marginal lands had been brought under cultivation.

3. THE DEMOGRAPHIC CHARACTERISTICS

The demographic situation in Kitui District is one of the most alarming in Kenya. The total population jumped from 95,000 people in 1910 to about 640,304 in 1989 (Kenya, 1989). Thus, the population increased by almost seven times in only seventy-nine years. From Table 1, it may also be noted that the District population more then doubled between 1910 and 1948 and also between 1948 and 1979. Table 1 also indicates that the annual growth rate has progressively increased throughout the twentieth century. The current growth rate is estimated at 3.8% per annum and the district has an overall density of about 30 persons per square kilometre. This density varies considerably from over 100 persons per square kilometre in Central division to under 30 persons per square kilometre in parts of Kyuso, Eastern and Southern divisions.

One of the major factors, which have fuelled the demographic flames in Kitui District, is the high fertility rate. In 1969, the overall rate was in the range of 11.97 for the 30-39 age groups to a low of 7.96 for the age group of 25-29 (Kenya, 1969). In the 1979 census, the fertility rates were still high with a mean of 9.37 for the whole district (Kenya, 1979). The current fertility is estimated at 8 (Kisovi, 1989).

Table 1: Population Growth in Kitui District 1910-1989

Year	*Total*	*Annual Growth %*
1910	95,000	-
1932	152,759	1.70
1948	203.035	1.68
1962	284,659	2.20
1969	342,953	2.60
1979	464,283	3.50
1989	640,304	3.80

Sources: Population Census Reports. Population numbers of 1910 and 1932 are based on hut counts by the colonial government. The 1989 population figure is from unpublished census data at Central Bureau of Statistics

A close examination of the 1989 unpublished population data at the Central Bureau of Statistics shows evidence of very little decline in Total Fertility Rate in the District.

By moderate estimates, the district's current population will exceed a million people in less than 20 years. In fact the doubling rate is estimated at only 17 years (Kisovi, 1989). This figure of a million people does not, however, seem excessive or startling, especially for a district of 22, 814 square kilometre-area, until one realises that ***more than 70% of the district is not suitable for rain-fed agriculture.*** If we also consider the fact that nine out of every ten people in Kitui District earn their living from agriculture, and if we assume that the current farming technology is to continue for a long time, which is very likely, then this aggregate is certainly high.

Unless something is done to resolve the population problem in the district there is a grave danger of a catastrophe, which threatens to destroy the stability of the ecosystem upon which the local people depend for food and water. Doomsday may be an inappropriate philosophy for people seeking solutions. In fact Maddox (1972) argues that it is defeatist and over reactionary in any context. His contentions, however, seem unjustifiably optimistic, for it is certain that never before has the land in the arid and semi-arid areas of Kenya been subjected to such stress and never before have the lives of so many people in these areas been so impoverished. The emerging population resource relationships are truly unprecedented.

4. POPULATION PRESSURE AND INTERNAL MIGRATIONS

Although population pressure is a widely used term in all disciplines that deal with human-environment relations, its definition is a major problem and its measurement is quite another difficulty. Different practitioners within the same discipline and those in different fields conceive of population pressure differently. However, they seem to agree that population pressure (PPR) means an imbalance between the resources of a community and its population. They argue that population pressure may be caused by either an increase in population, a deterioration of resources or both (Browning, 1970:72; Kay, 1970:363).

Consequences of PPR function as neither discrete nor as linear variables. Instead they interact synergistically, accelerate, and compound exponentially. As populations grow and require more from a finite resource base, pressure gains momentum with pervasive impact. Man-land and man-man balances tilt. Rural resources deteriorate progressively with lasting effects. Conditions of life worsen for the following generations.

As indicated earlier, Kitui District is one of the Arid and Semi-Arid regions of Kenya with a worsening population resource balance. Its rapidly deteriorating population-resource balance is a product of limited resource base and an explosive demographic growth rate. ***Only about 2.2% of the land in Kitui District falls within ecological zone III, which is of medium high potential. Rainfall of about 760-1015 mm. per annum is realised in many areas within this zone such as in Central Division and around the various hills in the district. The rest of the district receives 225-510 mm of rain per year. Much of this rain is torrential and is lost through run-off and evapotranspiration***.

Throughout the district, especially in more fragile ecosystems, signs of environmental stress and evidence of deteriorating human conditions have become increasingly conspicuous (Kisovi, 1989:140). However, talking of population pressure in Kitui District may be surprising to those familiar with the comparatively low population densities in the area. Nevertheless, crude density per se has been described as a misleading statistic (Hance, 1968:7). This is so since population pressure upon resources may occur where overall densities are low.

Numerous symptoms and clear signs of deterioration of environment and human conditions are now evident in Kitui. Among them are gullied and eroded hill-sides, deforestation, silt-laden rivers, declined crop yields, food shortage, land fragmentation and sub-division, use of marginal land, breakdown of indigenous farming systems and a swelling flow of urban bound migrants (Kisovi, 1989).

Results of my field work which I undertook in Kitui District in 1988-9 indicate that land fragmentation and sub-division is so severe in Central Division that now land parcels have declined to 0.5 ha per person in many parts of Matinyani, Mulango and Kyangwithya locations (Kisovi, 1989).

Increased soil erosion was reported by 84% of the 345 respondents interviewed in the field. Use of marginal areas (roadsides, steep slopes, more arid areas) was reported by 78.5% on average across the three main ecological zones (Kisovi, 1989:162).

Table 2: Net Population Flows into Different AEZs

AEZ.	*Actual Growth and Migration Rates*							
	1948 - 1962		1962 - 1969		1969-1979		1979 - 1989	
	G	M.R	G	M.R	G	M.R	G	M.R
III	4	-960	2	-1120	2	-1050	2.3	-2346
IV	31	+4100	3	-1660	4	-970	4	-3019
V	32	+3896	7	+3541	4	+2953	7	+2443
VI	35	+3569	2	+3050	4	+3840	5	+4231
VII	38	+4068	3	+4133	3	+4247	8	+5100

Key: G - Growth % p.a.
M.R - Migration Rate per 1,000

Source: Compiled by author from Population Census Reports: Kenya Colony (1950, 1962), Kenya Republic (1969, 1979, 1989)

One of the significant consequences of population pressure in Kitui is internal migration. As pressure builds in the relatively high potential zones of Kitui Central and Mwingi Divisions, it sends shock waves down the ecological gradient and spills over into the more arid lands. Table 2 presents population growth and flows into zones of differing Agro-ecological potential. Once the migrants settle in these fragile areas they apply inappropriate technology, which in time turns the areas into dusty wastes. Each year more and more people are moving from their settlement area looking for a place to graze and cultivate. My field data indicates that migrants from Central Division are largely moving to Kavisuni

and Yatta. Migrants from Kitui South, Eastern and Mwingi Divisions are already encroaching and in fact settling or cultivating in the State Lands and even in the Game Reserves (Kisovi, 1989).

It seems likely that as the population pressure becomes more acute in Central and Mwingi Divisions, movement into the adjacent areas will increase. Population pressure and land shortage will become an ever-increasing problem, which must be faced without further delay. As indicated earlier, already signs of environmental stress caused by overpopulation are evident throughout the district. Even in the sparsely settled areas, environmental deterioration caused as much by mismanagement as by overpopulation, is becoming a serious threat to future productivity of the areas. While vigorous efforts to rehabilitate the land through soil and water conservation have been undertaken, and indeed should be increased, so far they have been insufficient. Unless the basic problem of population pressure is resolved in this area, and in other areas with similar ecological and demographic conditions, further efforts in development are bound to fail. This is a challenge that faces us all.

The 1979 National Census recorded Kitui population as 285,800. Katoteni sub-location is now in Mwingi District and thus its population [766], is netted out. Initially, it was in Central Division, Yatta Location. Mui Location is now in Mwingi District, thus its population [9,796] is netted out too. Mui Location was initially in Eastern Division. The population of the entire Northern (Mwingi) Division [178,483] is also subtracted.

Table 2.1: KITUI DISTRICT: MAJOR CHARACTERISTICS

Area (Km^2)	20,555.74
Population density	25
Administrative divisions	8
Major sources of water	Ephemeral rivers, Dams, Springs, Scoop holes, Rock catchments
Main economic activities	Dry-land agriculture (maize, beans, pigeon peas, cow peas, green grams, sorghum, millet); Livestock keeping
Food availability	Food deficient zone

Source: Republic of Kenya (1997) - Kitui District Development Plan 1997-2001

In 1989, Kitui district population grew to 412,548. To arrive at this population figure, the population of the then Kitui North (Mwingi) Division [211,883] and that of Mui [12,932], Mutyangombe [9,563] and Nuu [5,697] locations, then of Eastern (Mutitu) Division, is subtracted.

By 1999, Kitui district population was 515,422 people with a density of 25 persons/km^2 (Republic of Kenya 1997, 1999). Table 1.2 shows the dynamics in population and density in present day Kitui District.

Kitui district is one of Kenya's marginal regions, according to Kisovi (1989). While the overall population density is low, and population pressure has reached crisis proportions because of the natural resource marginality at existing technologies and education. Population pressure in Kitui district is not a recent phenomenon. It can be traced back to the beginning of the British colonial intervention at the turn of the last century when the African Native Reserves were first established to confine Africans of specific tribes to specifically bounded areas. Carrying estimates indicate that the district was overpopulated in Central and Mwingi divisions by 1989 (Kisovi, ibid).

Despite recurrent famines and water problems, among other difficulties in Kitui district, the population has continued to grow and to increase pressure on supporting natural resources. Despite the obvious rapid population growth rate problem, there has hardly been any research carried out in this area to study its implications for development (Kisovi, 1989). Lack of information regarding the magnitude of population pressure in Kitui and other areas of similar ecological conditions remains a major problem of development planning (Sindinga, 1986; Livingstone, 1986; Mutiso, 1975).

Table 1.2: KITUI DISTRICT: POPULATION DYNAMICS AND DENSITY

Year	1962	1969		1979		1989		1999	
Pop.	191,023	214,406		285,800		412,548		515,422	
Population Density per Division		Division	Density	Division	Density	Division	Density	Division	Density
		Northern	15	Northern	48	Kwa Vonza	64	Yatta	35
		Central	42	Central	62	Central	117	Kabati	149
		Eastern	6	Eastern	10	Mutitu	12	Central	153
		Southern	8	Southern	11	Mutomo	8	Chuluni	139

Source: CBS- National Population Census and Household Surveys- Various

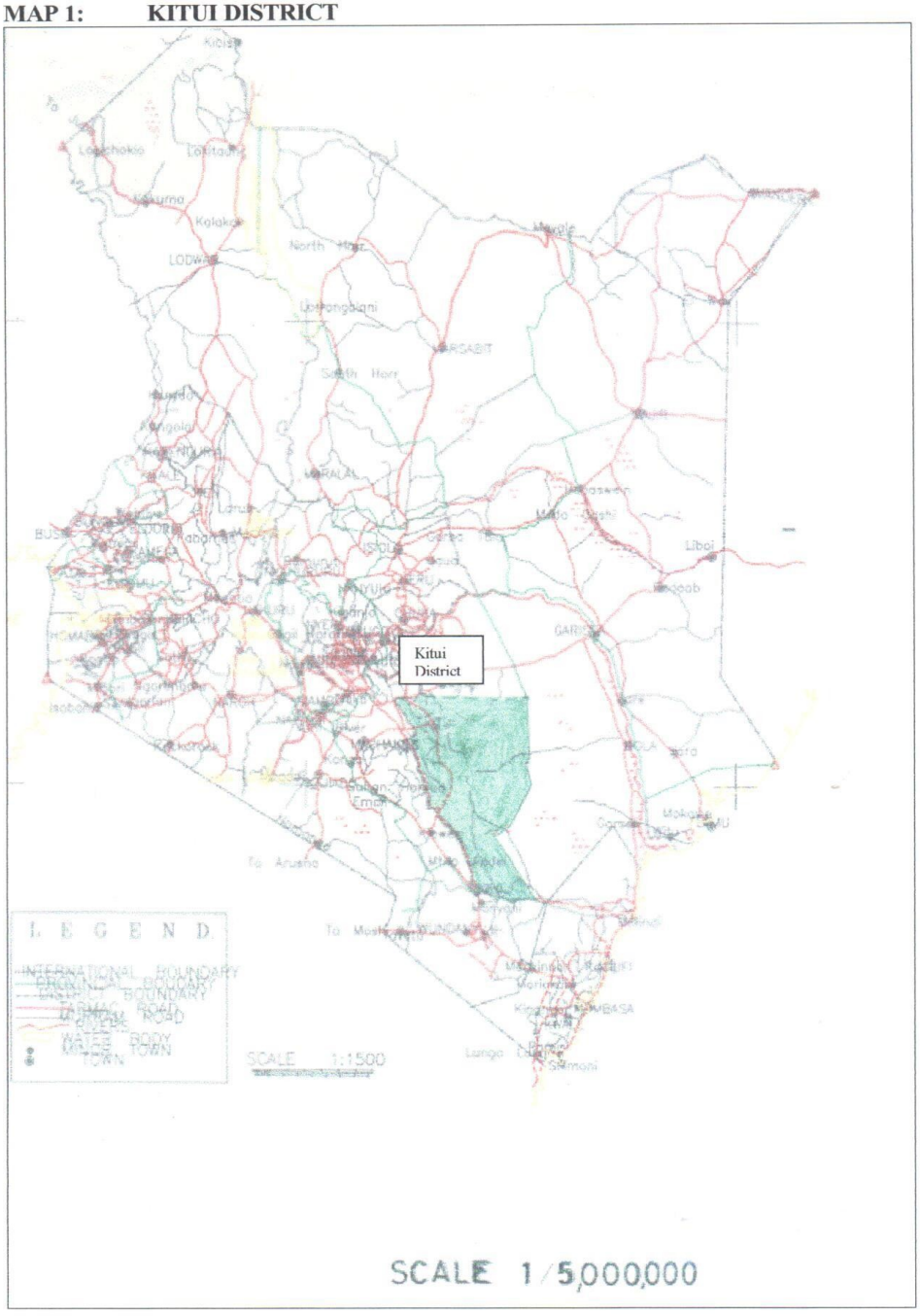
2.2.1 Population Dynamics and Land Pressure in Kitui District

The demographic situation in Kitui is one of the most alarming in Kenya. The 1969, population census recorded 342, 953 persons in the district (the old Kitui-including the then Mwingi division), with an annual growth rate of 2.8% per annum and an overall density of 15 persons per square kilometre (Republic of Kenya, 1969). The 1979 census put the old Kitui District population at 464,283 persons and an overall density of 20 persons per square kilometre (Republic of Kenya 1979a). In 1999, the population stood at 515,422 having increased from 412,548 in 1989. In Kitui, population density varies considerably from over 100 persons per square kilometre in Central [153] and Kabati [149] Divisions to fewer than 30 persons per square kilometre in Mutitu [29] and Mwitika [7] in eastern parts.

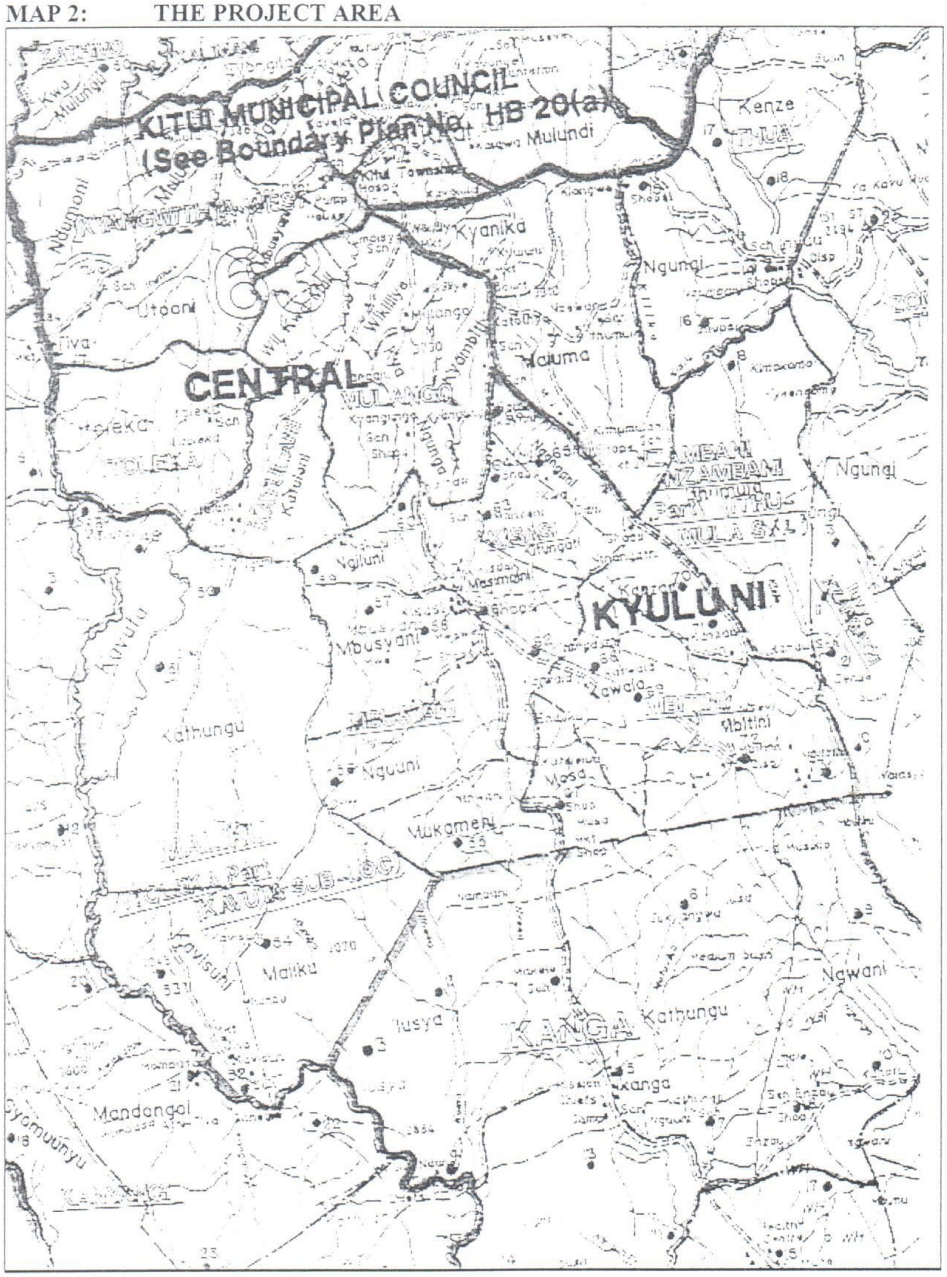
Field observations show very clear signs of population pressure. There are naked hill slopes at Mbitini, Ngai Ndethya, Kalelo, Maiumu, Ndakani, Kyaango, Ndilili, Endau and some hills in Mathima Location, among other places. The flatlands also have bare patches of land. There is high rate of land fragmentation and sub-division. The average land holdings per capita are very low (as low as 2 hectares per person) particularly in the Central Division. Land hunger is so high in the district such that land issues always occupy the centre stage in matters addressed by both religious and political leaders. During the year 2001, several cases of politicians trying to allocate privately owned land to the "landless" in the district have been reported by the press (*Daily Nation March*, 2001).

According to Kitunda (1998) and Kisovi, 1989), indigenous people of Kenyan's dry lands had lived for centuries in a state of equilibrium with their dry lands until the advent of the British rule. Studies in support of this argument indicate that pastoralists are almost the only people capable of making good use of their semi-arid and arid environments (Swift, 1977; Porter, 1966; Conant, 1965; Bernard, 1977; Lewis, 1961). Through a process of trial and error, the inhabitants had developed survival mechanisms for these delicate ecosystems.

MAP 1: KITUI DISTRICT



MAP 2: THE PROJECT AREA



During British colonial rule, (1893-1963), fundamental changes to the Kenya's dry lands were set in motion. Convinced that the traditional practices were chaotic and primitive, the colonial administration sought to introduce "rational" land development. The most productive lands were alienated for commercial farming and livestock production, depriving the pastoralists of their essential dry season pastures (Odingo, 1971). The market economy driven development, coupled with population pressure, arising out of improved health services, destabilised many indigenous farming systems leading to a progressive reduction of fallow time and a decline in the stability of agro-pastoralism as practised in districts like Kitui. Carving out land for other uses, such as game conservation, urban development and cash crop cultivation did bring similar results (Sindinga, 1986).

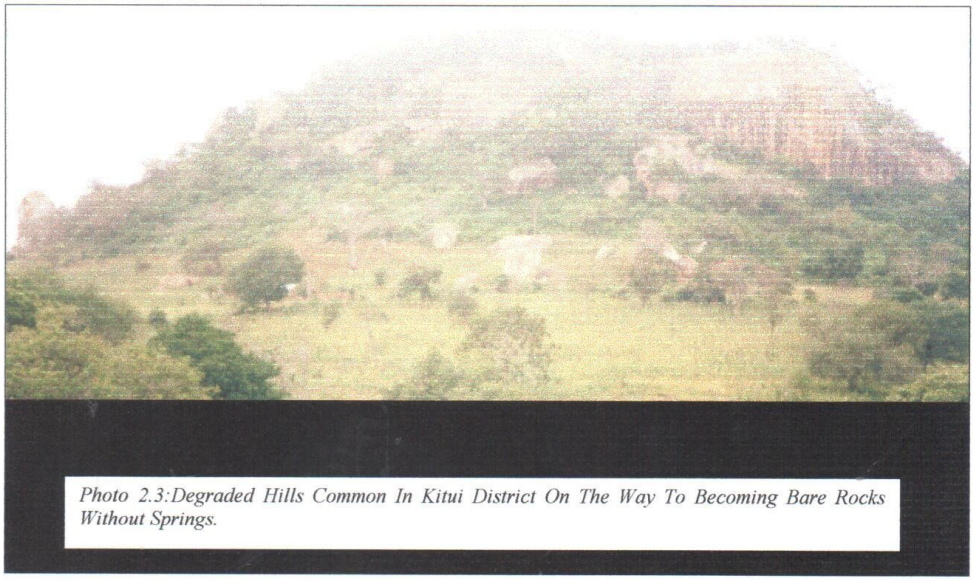


Photo 2.3:Degraded Hills Common In Kitui District On The Way To Becoming Bare Rocks Without Springs.

A case in point, in Kitui, is the devastating results brought about by the carving out of the grazing lands of the people of southern Kitui to create Tsavo East National Park. The colonial chiefs who used the excuses of creating national parks, grazing reserve lands, as in B1 and B2 Yatta, and other techniques, e.g. milk cattle reserves, to create their family extensive private land in the district, aggravated the land scarcity problem (Mutiso, 1977). People were moved around by Kitui chiefs over and above the colonial government plans leading to pressure in very small pieces of land. The large livestock herds, owned by local elites, caused a lot of damage to the land. Some of these areas have suffered such extreme degradation that reclamation of their biotic functions may not be feasible. The effects are quite evident in many parts of the district as shown in the photograph above.

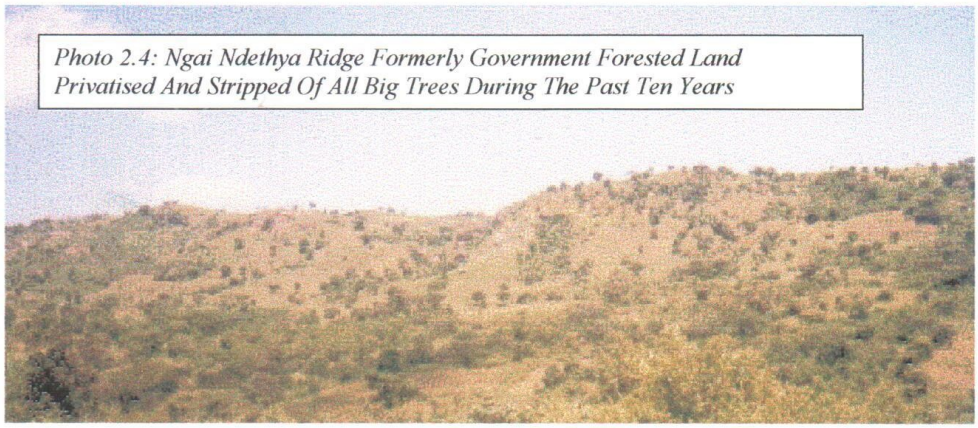


Photo 2.4: Ngai Ndethya Ridge Formerly Government Forested Land Privatised And Stripped Of All Big Trees During The Past Ten Years



Photo 2.5: Systemic Soil Erosion In Kenze, Mathima Location, Mutomo Division

Historically, the agro-pastoral population of Kitui were trans-humant seasonally (Akong'a 1985). Colonial encouragement of fixed crop agriculture, particularly the cotton campaigns of 1934-1936, forced the *Misyi* to become permanent and limited the range of *Syengo*. These actions led to localised degradation of the local areas in the hills and regional denudation in the plains (Kisovi, 1989). Meanwhile, in the former reserve grazing areas, used seasonally as *Syengo*, bush and tsetse encroached (Bernard, 1977; Mutiso, 1977).

The fixed crop farming in the marginal lands *(Maweu)* had a devastating effect on local utilisation of micro habitats normally considered too poor for crop production i.e. cultivation on steep slopes, removal of vegetation for charcoal burning, and grazing in all manner of places represent a desperate mechanism for survival by exploiting every marginal corner of these harsh lands (Wisner and Mbithi, 1973). During the period of field interviews (the month of June and July, 2001) it was estimated that at least three (3) tons of charcoal are transported out of Mathima location (in Mutha division) each day. Ndakani location is particularly notorious for charcoal production. The level of forest destruction, for purposes of charcoal burning, has reached a crisis level. This puts water catchment areas in a very sorry state as predicted by Mutiso (1977) while writing on the stripping off vegetation of Kisiio river watershed. Water is becoming more and more scarce as the destruction of forest cover continues unchecked not only in Mutha division but throughout the district.

As stated earlier, the spatial and the ecological design and practices of the traditional Akamba life provided a sustaining foundation for their economy. Originally, pastoral activities predominated in the Akamba economic system, but by the beginning of the 19th century there was a shift towards mixed agro-pastoral economy. According to Kimambo (1970) this shift in economic practices can be attributed to population pressure. In spite of this, livestock, particularly cattle, continued (and still continue) to play important subsistence and social roles. The traditional strength of Akamba attachment to livestock was indicated by the importance of *Syengo* (cattle posts) as pioneer outposts in territorial expansion as well as in diversifying land use over many ecological niches (Munro, 1975). The dispersal of livestock to different *Syengo* provided a check system against natural calamities like drought and diseases as well as managing the ecology in such a way that bush did not encroach thereby leading to the tsetse keeping the land away from production. Simultaneously, it also provided some egalitarian norms for never in traditional society was a household allowed to establish a *Kyengo* alone!

The Akamba oral traditions assert that the community's grazing lands in the last century extended as far as east Hola in Tana River District and to the north eastern, as far as Garissa. To the west, the Akamba grazed as far as Mwea plains, Katw'anyaa and around Ol Donyo Sabuk (*Kiima Kya Nzavi*- the hill of dolicos lablab to the Kamba and the hill of buffalo to the Maa speaking peoples!) not to talk about their incursions into Kajiado – all the way to Magadi.

The impact of colonial rule in Ukambani can best be understood through a class interpretation in a geographical setting. Concentration of infrastructure (social and economic amenities) in high potential hills of Ukambani changed the pre-colonial trans-humant practices and drew people back into the hills to gain access to colonial society's provisions. Those who were in the uplands, and those who returned to them became the colonial privileged class *(the Asomi)* through education. They gained an advantage over those who were at the dry periphery who also did not get the benefit of education. Ultimately, they achieved status and special access to land and livestock and were supported by the colonial regime. The privileged established cattle ranching projects in Yatta B1, Yatta B2 Ikutha, Katse, Kanyonyooni, Nzalai and many other places in Kitui in the 1950's. After independence, the *Asomi* converted these ranches into ranching cooperative societies. These include Kanyonyooni, Katoteni, Mikuyuni, Ngunyumu, and Mbeu cooperative societies (Mutiso, 1977). Land adjudication in the wetter parts finally formalised the mal-distribution of land and enlarged the problem of land hunger in Ukambani (Munro, 1975).

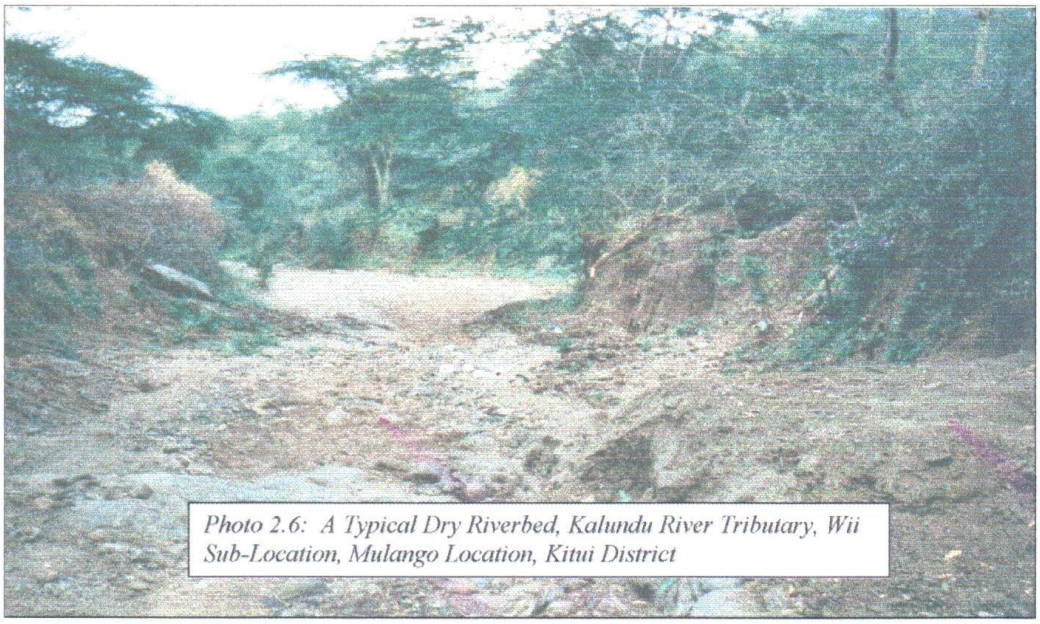


Photo 2.6: A Typical Dry Riverbed, Kalundu River Tributary, Wii Sub-Location, Mulango Location, Kitui District

The 1990's saw a shift in population particularly from Central, Kanyangi and Ikutha towards the under-populated areas of Ikutha division in Mukameni, Mutonya Itho and Mukuanima sub-locations. The *Asomi* have made land in Kanyangi so expensive that the poor sell off theirs and move to the hitherto mentioned areas. These areas border Tsavo East National Park and there is a severe competition for water and grazing land between human beings and wildlife. Wild animals pose danger to human life and wreck havoc on crops. During the dry season, people sneak into the park in search of domestic and livestock water and pasture for their livestock. On several occasions, the Kenya Wildlife personnel have terrorised the villages bordering the park accusing them of poaching. According to the respondents, creation of the park has denied them some of their most reliable pastureland and water sources.

Mutiso (1975) argued that creation of a privileged class *(Asomi)* and declaration of the former Akamba grazing lands as crown lands, denied the ordinary Mukamba (singular for Akamba) access to adequate land for his own subsistence. These forces inherited from the colonial era have been carried forth to the present, causing population pressure to continue tearing the Akamba society and landscape apart (Kisovi, 1989). Healing the society and the landscape is the central issue in Kitui development.

In nutshell, Kitui district is characterised by fragile ecosystems throughout the district. These have been exploited by a privileged set in society since the establishment of colonial society.

BOX 2: PARKS, SECURITY AND WATER IN OLD SOUTHERN DIVISION

The two most important issues relating to access to production water historically, in the old Southern Division (currently Mutha, Ikutha and Mutomo Divisions), are security and the creation of parks. When Tsavo Park was created in 1947, it is estimated that 50% of the then population were moved out of areas taken up by the park. This had tremendous influence on land use in the division for most of the people were livestock keepers and their livestock grazed and drank in the areas taken over by the park. Very significant was the Tiva River flood area. This area used to be the ultimate drought /dry season grazing area for the Tiva just disappeared into this flood area. This is the Ndia Ndaasa area, stamped into Kamba folklore as the ultimate survival site. People were able to cultivate in it during major droughts over and above being the reserve grazing area for many Kitui people not just the southerners. It was ecologically a premium area. The population thrown out of the park area basically concentrated in the old Kanziko and Ikutha locations. The land deteriorated very rapidly and it has not recovered up to today. The attendant overgrazing led to deterioration of the land resource as livestock concentrated on utilizing the hilly areas. The resulting gullying and lack of ground cover led to drying of streams from the hills, which at the turn of the century were perennial according to early missionary records and Kamba oral traditions.

The old Mutha location did not have as a heavy population as the other locations in 1947. Although it did not have access to the eastern Kitui State lands, its population had grazing options not just into the low populated Voo and Mwitika locations but could spill into the Zombe and Endau locations for which grazing was good and the Thua and its tributaries provided water.

As the impacts of the creation of the Tsavo Park spread in the decade of the fifties, cattle movements changed. The area between the Thua and the Park became the prime grazing areas. During the decade of the sixties the Yatta also became a prime grazing area. Water for the latter was from the Tiva and the Athi. This Yatta area was much drier than the Thua flood plain and was not as central as the other.

After independence in 1963, Kitui population exploded into the Thua channel and settlements were made from Enyali all the way to Kakya /Waldena in Tana River. This expansion took over what in colonial times was called Kitui Eastern State lands, which were zoned not to have permanent populations for they were the buffer between the Orma/Somali and the Kitui Kamba. The seventies proved the fiction of the Eastern Kitui state lands. There were permanent cultivation and grazing operations established all the way to Kakya/Waldena. These settlements supported the poaching, which decimated Tsavo in the seventies.

To keep the old Mutha population out of the state lands, large-scale water pumping systems had been established in the last days of the colonial period to serve the western parts of Mutha and Voo locations. The pumping was from the Thua River. These collapsed in the decade of the nineties as the pumps were pulled out and sold into the coffee producing areas. Recently, the Mutha town gravity scheme has been rehabilitated. A pumping scheme is in place for Voo town. Given the distances between the scattered populations, these schemes are not adequate.

In the eighties, a donor concentrated on building rock catchments in the division. Most of the construction was in Mutomo, Ikanga, Ikutha and Kanziko in descending order. This technology did not scatter water provision to many areas for it is dependent on sizable rocks being available.

Insecurity, in terms of raiding of cattle and goats, is a phenomenon introduced into the area from the droughts of the eighties and nineties. There have been assorted clashes between the Kamba, Orma and Somali. The most serious were in the nineties. The ultimate impact of the clashes was in the early nineties as impacts of the assorted Somali factions spread all the way into Mutha and Kanziko. It is argued that the main raiders were Somali who leapfrogged the Orma to raid the Kamba. Consequently populations collapsed back towards Mutha and Kanziko towns. The ripple effect impacted on the whole of the old Southern Division as well as the eastern fringes of former Central and Eastern Divisions.

The recent creation of the Kitui South Game Reserve has formalized the collapse of Kamba populations back to the hills and out of the former Eastern states lands. Some Somali clans are settled west of the reserve around Enyali. They together with their Kamba and Orma allies are accused of continuing the insecurity in the border areas of Kitui and Tana districts not to speak of poaching in the Tsavo East National Park.

The net effect of all these key issues impacting on the Southern Division's land use system and attendant population growth, driven by natural growth and in migration, is the impoverishment of the people. Large-scale cattle

production systems have collapsed. Those families, which before lived off this extensive livestock production system, have collapsed into crop agriculture with limited livestock (small stock) keeping. This is a coping mechanism to the loss of land to parks and raiding. Impoverished cattle keepers find options in crop agriculture. Yet the area is of limited crop production without conservation and /or supplementary irrigation.

The development need therefore is to implement a water provision technology which will, among other things:

a. Cater to the population, which is not within the reach of the limited gravity or rock catchment systems.
b. Address provision of water for high value crop production.
c. Address provision of water for schools.
d. Address the issue of water for animals in the Tsavo Park and Kitui South Game Park for if structures are build in the populated areas proximate to the parks the animals will move out to use it.

We believe that the technology meeting all these criteria is the sand dam technology.

2.2.3. Water Sources

Water is a common denominator and a major development input; and thus remains the most essential development commodity in Kitui District. The search for water is a significant preoccupation of the people of Kitui District as there are only a few water sources such as seasonal rivers and a few transient springs to serve them. The major sources of water are ephemeral rivers. Athi River, to the southwest periphery, is the only permanent river. The Athi River is the southwestern boundary between Kitui and Machakos districts. Seasonal rivers such as Nzeeu, Tiva, Kalundu, Mutendea, Ndiangu, Mwitasyano and Kauwi drain the central and southern regions of the district. Mui, Ikoo, Thua, and Enziu drain the eastern region. Tyaa and a part of Mwitasyano drain the western parts. These seasonal rivers flood during the wet season and turn into dry sand beds during the dry season. These sand beds on seasonal rivers are not only important sources of water and sand for construction purposes, but are also part of natural conditions that have shaped human history in Ukambani (Kitunda, 1998).

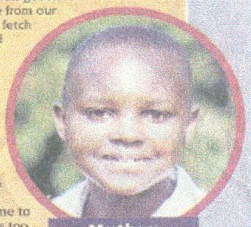
The population residing along the rivers does benefit from subsurface water in the sandy riverbeds. Distance to source, frequency of water fetching, trips and number of persons per trip varies between the wet and dry seasons. Sources of water are usually rare during the dry seasons. In some places, women walk as far 25-30 km, a round trip of around five hours returning with water of questionable quality (Mutie, 1993). However much of the available water is relatively of good quality partially due to minimal use of agricultural chemicals and little industrial discharge in the river systems. The size of the household, economic status and proportions of females in the household positively influence the domestic demand for water in the household (Kimuyu, 1998).

Akong'a, (1985) saw water shortage as the greatest barrier to better conditions of living in Kitui. Water scarcity in this district is linked to unfavourable weather conditions, non-availability of permanent rivers across the vast district, few seasonal streams and inadequacy of both internal and external resources to develop alternative ways of water provision (O'Leary, 1979).

CENTRALITY OF WATER IN ASALS: YOUNG NATION ARTICLE in The Daily *Nation, 3rd October 2001*

In ASALs, water problems concern everybody, including the school-going children, for the problems affect their academic performance. After trekking for long distances in search of water, concerned pupils are too tired to attend school at times. Even when they do, punctuality and concentration is compromised.

These pupils cite various problems associated with water scarcity. During the dry season, distances to water sources are long and scoop holes infiltration rates are low. Sometimes the scoop hopes are too deep posing risks to water harvesters. Issues of insecurity and fear of attacks by wild animals are also highlighted.

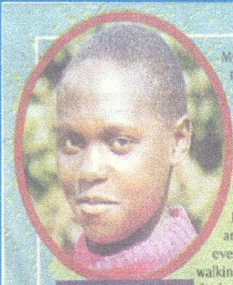


Mutheu

I come from Kitende village and school. There is a borehole which was dug by a non-governmental organisation some distance from our village. This is where we go to fetch water. Our land is very dry and dusty. During the dry season, we go for as many as 20 kilometres in search of water.

Girls suffer a lot because of carrying heavy water containers on their back. We get to school late when we go to fetch water in the morning. We get tired and concentration is a problem. I go to fetch water every day because there is only me to assist my parents. My sister is too young to carry water. I go to the borehole with my neighbours. Sometimes this bore hole dries up and we have to walk long distances looking for water. I have actually never seen a big river in my whole life.

Mutheu Musyoki

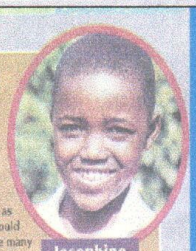


Lizy

My village is called Kikaluni. There many people living here. We fetch water from a well which was dug by the villagers. The well is about six kilometres from our home. I only go to fetch water on Saturdays and Sundays unless there is no water in the house. We set off to fetch water very early to avoid long queues. Girls like me carry the water on their backs.

I often carry a 20-litre jerrican on my back and a five litres one with my hand. One evening we came across a jackal as we were walking home. We let go of the water and quickly climbed up a tree while screaming. We were rescued by a neighbour who took us home. It is very scaring when you get late at the well. The government should help us get water so we can draw it from near our homes.

Lizy Ndunge.



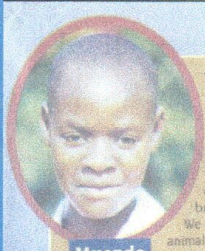
Josephine

I go to the river every day after school. The river is four kilometres from our house. On the way to the river, our neighbour's dogs bark at me and I have to run before they can catch me. The water in the river is usually dirty but I don't have a choice.

I use a 20-litre container which I place on my back. It is very heavy.

I hate people who wash clothes in the river as this makes the water dirty. The government should pump water to all homes because children face many problems while going to fetch water after school. There is normally little time to do one's homework after going to fetch water in the river.

Josephine Wambua, 12
Class Six



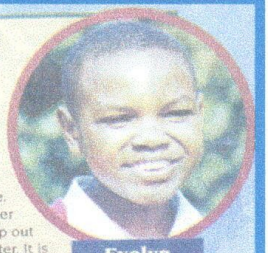
Muendo

There is no piped water anywhere near our village of Ikombe. There is also no river. We fetch water from a bore hole which is about three kilometers away. Most times, it is very difficult to get water from the bore hole because everybody depends on it.

I only go to fetch water during the weekend. We wake up as early as 5.am to go for water with my brother who is 19.

We make sure that we are in a group for fear of wild animals. I return to the river three times in a day and the water is stored in buckets. Sometimes we stay waiting at the bore hole for up to three hours. During the dry season we walk for as many as three hours in search of water. It is normally very tiring. The water is used for drinking, washing and bathing. This water is not treated and many children fall sick.

Muendo Mbatha, 13
Class eight



Evelyn

I come from a village called Miyanyani which is in Mwala location, Machakos District. Water is very essential in our day to day life. Without water life would not exist on earth. We fetch water from a seasonal river called Miu. The river is five kilometres from our home. During the dry season, the river dries up and we have to scoop out sand until we reach the water. It is tedious, tiring and dangerous. Sometimes we dig until it is very late. We also have to go up a very steep hill which makes one very tired. During the dry season, we go from one river to another looking for water. We therefore request the government to get us piped water so that we may go to school without all these struggles.

Evelyn Mbuvi, 13,
Class eight

Box 3: Pleading With The Water God: How Water Limits Mutomo Market Growth

Mutomo market is approximately situated 60 km. to the south from Kitui town. It is Mutomo sub-district headquarters. Syombua Muange is a water vendor in Mutomo Market. She says that the business of selling water in Mutomo is one of the toughest businesses to run in what she calls, God forsaken town. During the dry season, she says, the town has two alternative sources of water: scoop holes in Nzeeu river and Mbunya-aka rock catchment. Nzeeu river and Mbunya-aka are 8 km and 5 km respectively from Mutomo town. Water from Nzeeu is salty and it goes for Ksh. 25 while water from Mbunya-aka goes for Ksh. 30 per 20-litre jerrican. She says that the quality of water from Mbunya-aka is "clean", however the source is characterised by hilly terrain making it dangerous to people and donkeys. The source is not accessible by other means of fetching water like motor vehicles and carts. Therefore, it is mainly women who fetch water from this source, and probably, this is why the source is called Mbunya-aka (Women pincher).

During the dry season, Syombua says she only manages two trips a day and fetches four 20-litre jerricans. She only sells two 20-litre jerricans and reserves 40 litres for domestic use. She says if there were a source closer to Mutomo she would be in a position to increase her trips and sales.

During the wet season, water vendors fetch water from Yambuu rock catchment and sell it for ten shillings per 20-litre jerrican.

Raphael Nyoka is the Finance Administrator in Mutomo Mission Hospital. He says water in Mutomo remains a major impediment to developing the hospital. Mutomo hospital has to spend enormous resources in search of guaranteed supply of water through out the year. The hospital has three major sources of water, Ndovoini borehole, Kyome earth dam and its extensive roof catchment system. The hospital uses its own resources to pipe water from Ndovoini and Kyome. Water from Ndovoini and Kyome is pumped and stored in large storage tanks situated on relatively high altitude in the hospital grounds. This enables the water to flow from the water tanks to the hospital by gravity. It also has water-pumping generators at the sources. Mr. Nyoka says if water could have been nearer and readily available, the resource committed to be diverted to diverted to enhancing medical services.

Water from Ndovoini is salty and mainly used for washing. Major users of water in the hospital are the in-patients and the hospital staff. Water rationing is also practised. Water from the storage tanks is opened for members of staff one hour in a day. The staff also gets a supplementary 40 litres per day. Kyome earth dam is mainly used during the wet season. This is in order to compete with high evaporation and seepage rates.

Mr. Patrick Kavisa and Mr. Cornelius Ngala, head teachers at Kitoo and Kiange Primary Schools respectively, say retaining teachers in schools around Mutomo market is an impossible task. This is because of the high cost associated with water compared to other living expenses. For example, Mr. Kavisa, resides with a family of three in Mutomo town, the family uses 40 litres of water per day, which they buy at an average of Ksh. 20 per 20-litre jerrican through out the year. This translates to Ksh. 1,200 per month compared to house rent of Ksh. 500. He further says the cost of boiling drinking water is Ksh. 3.50 per 20 litres translating to Ksh. 251 in a month. Naturally, the cost of water is supposed to be cheaper than the cost of housing which is not the case in Mutomo.

Mutomo Academy is a relatively new mixed day and boarding primary and secondary school with a population of 80 students. Mutomo Academy harvests rainwater by roof and rock catchment and stores it in ground water tanks. The Principal, Mr. Raphael Kituva says water problem is acute during the dry months of September and October. He says the institution spends Ksh. 18,000 on water during these months. He can't really gauge the amount of money used in boiling drinking water in the school. He predicts that the water problem is bound to become more serious with the increasing school enrolment. He says that for the school to prepare itself for increased enrolment, a well is being dug in the school compound. He says the locating of the well was not professionally done and he doesn't know how deep they will have to dig to get this precious commodity. At the time of the interview, the well was 60-feet deep.

Water for large-scale use is sourced from Matinga earth dam (in Ikutha Division), roughly ten kilometres from Mutomo town. Tiva (over ten kilometres) and Ntheeu (about 8 Kms.) rivers are not appropriate for large scale harvesting due to slow infiltration rates and contamination form Kitui town.

Relatively well-off households have initiated private search for water. This is the case with the households of Mr. Elijah Nthenge (businessman) and Mr. Dominic Ndunda Ntheeu, a businessman and a local leader respectively. Both

households harvest rainwater. They have large ground water tanks. Besides, the two households have dug deep wells. Mr. Elijah's well is 83 feet deep and provides water through out the year. However, he says the water from this well is hard. Lack of technical expertise in locating wells remains a big challenge and makes the exercise quite expensive. Mr. Nthenge says use of local knowledge is employed in locating the wells. Presence of Munina (acacia eliator), Mukuyu (fig tree), and Mukomoa trees imply presence of ground water. However, he talks of a disappointing experience of one Mr. Musyoka Kumetethya who did 120 feet well and failed to get water. Mr. Ntheeu talks of another individual who has dug 50-feet twice and failed. The cost of digging one foot of a standard well stands at Ksh. 500.

But what is the impact of failed water projects in Mutomo to community participation levels? Mr. Ntheeu says Mutomo people will stop at nothing in pleading with the Water God despite the fact that their earlier efforts have not borne fruits. Mr. Ntheeu regrets that all along they have gotten their development priorities right, but the tried solutions have always missed the point. He says water has always been the first priority. He narrates, with a lot of pain, the history of failed water projects in Mutomo town. First was the Mutomo Water and Soils Conservation project in the early 1980's, followed by the rock-catchment project of DANIDA in the 80's and the 90's. The rock-catchments are only useful during the wet season when water is readily available from other relatively nearer alternative sources. Further more, he observes, the projects lost focus when it came under the Ministry of Agriculture and Livestock Development instead of the Ministry of Water Development, which is more relevant.

Mr. Ntheeu laments that one-half of the enormous resources employed in this project could have been sufficient to address Mutomo water problems if the right technologies were applied. He says the local leaders and communities were not consulted in the choice of the technology. He describes the activity as a mere laboratory experiment.

Ntheeu advises that the only possible and permanent solution to water problems is earth dams. He says the earth dams established by the colonial government (e.g. Matinga in Kyatune) remain major sources of water in some places in the division. He say in every location there are either rivers or/and streams but ironically carrying water to the Indian Ocean. There are cases of broken earth dams attesting to the fact that the water passing through these rivers/streams is a lot and can cure Mutomo water problems. He recommends two earth dams per location.

What waterborne disease mitigation measures do Mutomo residents engage in? Mr. Ntheeu says this is only limited to boiling. However, he points out that the practice is not common. He advises that safe water does not stop at boiling alone. He cites examples of people washing utensils with unboiled water before serving drinking water, sort of neutralising the boiling effort. He talks of cases of boiled water not properly stored exposing it to further contamination and individuals using unboiled water while brushing their teeth under the pretext that they spit it out.

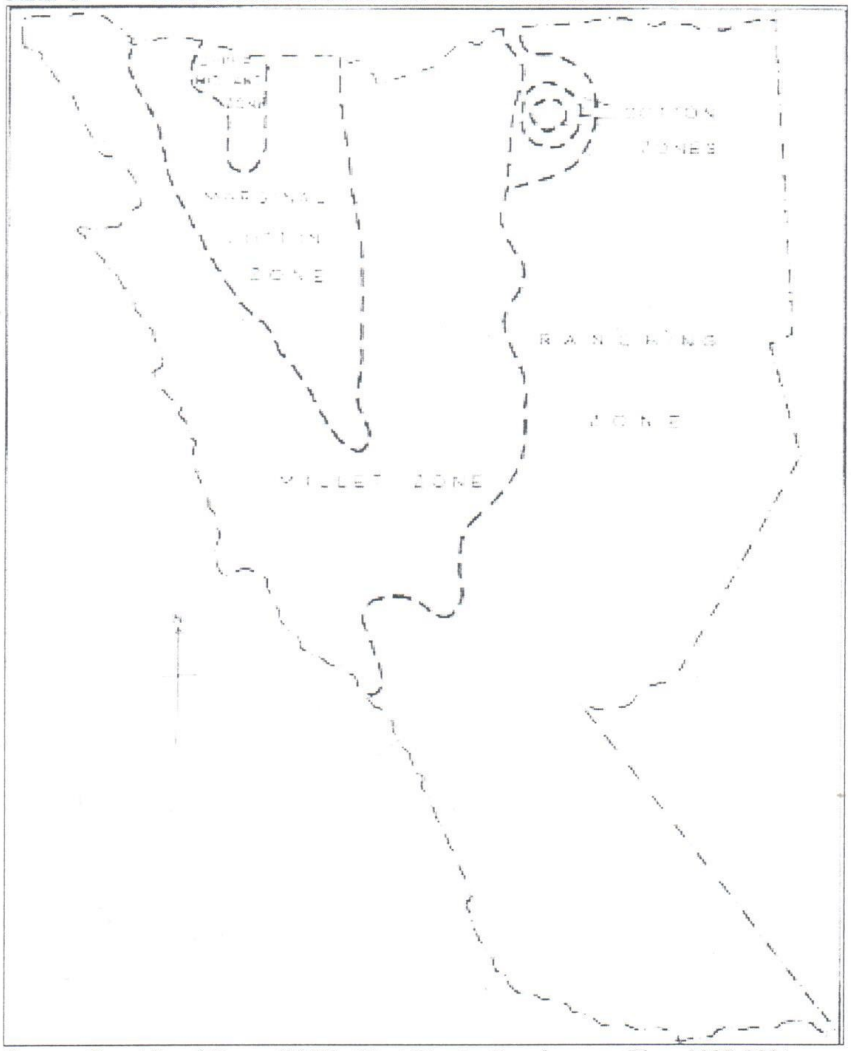
He also observes that presence of toilets is also uncommon. He attributes this to lack of understanding. Lack of eye opener to force people out of their old fashioned and ignorant practices remain a major issue.

Vendors bring vegetables and fruits for Mutomo market from Kitui (District headquarters) and Kibwezi (in Makueni District) towns.

2.2.4 Agricultural Activities

The low amount of rainfall in Kitui makes crop farming a marginal and risky business, since in most seasons, rains do not supply adequate moisture to meet crop growth requirements. The rainfall is poorly distributed, much of it falls in torrents and within a very short duration (Kisovi, 1989, SASOL and Maji na Ufanisi, 1999). This problem is attenuated by the high temperatures (ranging between 26 and 34 degrees centigrade) leading to very high rates of both evaporation and evapotranspiration throughout the year (Republic of Kenya 1997).

MAP 3: KITUI DISTRICT AGRO-ECOLOGICAL ZONES



Source: Republic of Kenya (1997): Kitui District Development Plan, 1997-2001

There is high rate of land fragmentations and sub-division. The average land holdings per capita are very low (as low as 2 hectares per person) particularly in the Central Division. Land hunger is so high in the district such that land issues always occupy the centre stage in matters addressed by both religious and political leaders. During the year 2001, several cases of politicians trying to allocate privately owned land to the "landless" in the district have been reported by the press (*Daily Nation*, *March*, 2001).

Box 4: Poverty and Food Security: Miambani and Maliku Locations Cases

Poverty Where There Is Food Security

Field observations show that Miambani Location is the most fertile location in Kitui district yet bad communication leads to ***extensive poverty in spite of food security***, as the population does not have access to markets for their extensive agricultural production. Water for household use and production is not a problem in this location for practically every household has access to either river water or well water. The flood plains of Thua river and its branches assure this. Rainfall is more than adequate although we cannot substantiate this formally for recording stations do not exist.

The socio-economic study included this location to check whether the SASOL decision to leave it out of the water sources development activities was justified. From interviews in the location water for domestic purposes is within reach for most of the households in Miambani location during the dry season. Sixty one (61) per cent of the respondents reported that they fetch water from sources, which are less than two kilometres from their homes. Thirty two (32) per cent fetch water from distances which fall between 2 and 5 kilometres while 3% fetch water from sources which are more than 5 Km.

Seventy-five (75) per cent of those interviewed get water from scoop holes whose depth is less than 5 feet while only 3% fetch water from scoop-holes of more than 5 feet. Data show that, 43% of the respondents spend less than 1 hour to and from their main water sources, 39% of the respondents spend between 1 and 2 while 15% of those interviewed spend between 2 and 5 hours.

It then can be concluded that the decision by SASOL to leave the location out of the water sources development activities was justified.

Miambani location is between the Central Kitui range and the Mutito Range. Road access, from the east of the location, is after negotiating the drop from Kitui town through a very twisted road so dangerous that the locals call it God Help Me (Ngai Ndethya). Historically, there was access in the west of the location from Mutonguni location. This western access is so rough and dangerous that nobody has motored through it during the past five years. This communication problem is so serious that the Chief, Assistant Chiefs and local leaders told us during fieldwork that they did not agree with the statement in the current District Development Plan which states that for the whole district the priority is water development. The locations priority according to them is creation of access roads. They were going to petition the District Commissioner on this issue.

Most of Miambani Location agricultural land is matiko *(flat lands in the flood plains),* which is quite fertile for production of maize, millet, sorghum, cowpeas, pigeon peas, beans, green and yellow grams, peas, pumpkins, *Mongu* (cucurbit species), bananas, fruit trees and assorted vegetables. It has possibly the widest range of crops in the district. Yields are excellent for the rich alluvial soils have not been exhausted as soils in the areas in proximity to Kitui town. Most of the produce is wasted for lack of access to markets. We therefore have the ironical situation where people are poor although they have farm produce rotting in the fields.

The state of the road network inhibits the residents from accessing external markets for their produce as well as their travel. Only one dilapidated vehicle leaves the location for Kitui town every day. The few traders who are courageous enough to venture into the location to buy farm produce pay very little. During the fieldwork, a kilogram of maize was being bought for Ksh. 3 whilst in Kitui town – less than 30 km. away- it was being bought at Ksh. 12! This is the "undiscovered" food basket of Kitui district. According to the respondents, if served with a proper road network, the location can perhaps feed the whole of Kitui district.

Poverty And Food Insecurity In High Potential Black Cotton Soil Areas

Significant parts of Kitui district have what is generally called black cotton soils. It is estimated that they may constitute about a quarter of all the Kitui District land. These soils are agriculturally very productive. Almost all of Maliku Location has these soils. Technically speaking, the most dominant soils in the location are Vertisols, commonly misnamed "black cotton soils". These soils have poor drainage properties

and are difficult to manage. During the wet seasons, the soils seal up thereby limiting absorption of water and thus recharge of the ground water table. During the dry season they develop very deep cracks thereby allowing accumulated water to drain away into a lower thieving layer. This thieving layer (usually made up of carbonates very hard to dig when dry and very soft if wet) presents a further challenge for water seeps through it as soon as it gets wet. It does not provide a secure base for masonry dams therefore for their weight enables them to sink through it. During the dry and wet seasons, masonry cement structures normally collapse. Frima et al (2002) describes the soil as "notorious".

The populations use these lands only during the wet periods. For most of the year, the land is idle. It is not even available for grazing for there is no water for livestock. Earlier attempts by an assortment of development partners (including the colonial government) to develop water sources (particularly earth dams) have failed miserably where these soils dominate in Kitui district. The issue of assuring utilisation of these lands for production was not urgent when the district population density was low. However, given the demographic explosion, over the last forty or so years, significant numbers of people have moved into areas dominated by these rich soils which lack water sources. They suffer poverty on these potentially very productive lands. The first step in alleviating poverty, through assuring food security, is provision of water. To date SASOL has not build water sources in areas of black cotton soils for the simple reason that the dominant technology it uses- masonry dams- is not suitable.

Due to these technical limitations, of construction of affordable water provision structures, on very good for agricultural black cotton soils, fantastic water shortages exacerbate food insecurity.

Maliku Location was surveyed during the study. The data shows that, during the dry season, 21% of the respondents access water from sources, which are less than two kilometres from their homes, 25% fetch water from distances ranging between 2 and 5 kilometres while 38% fetch water from distances ranging between 5 and 10 kilometres. Sixteen (16) per cent of the respondents fetch water from distances, which are more than 10 kilometres from their homes.

During the wet season, the distances shorten, though not significantly. The percentage of households getting water from sources less than two Kilometres is 29%. Majority of the households (38%) fetch water from sources between 2 and 5 kilometres. Twenty-two (22) per cent source water from distances more than five kilometres. The data showing people within short distances to water sources can be explained by the fact that the Tiva River and its tributaries have influenced settlement in the past. Very large areas of the location have no people. Land, which could be used for production, is thus not available for there are absolutely no water sources.

From its formation SASOL has been aware that black cotton soils are potentially very important for long-term food security of the district. It was mainly on this basis that a relationship was sought with TU Delft to assist SASOL in the research and development of techniques to be used for construction of water sources in the black cotton areas. A group of Engineering students from the Technical University, Delft The Netherlands, is currently (2002) working on the problem.

Agricultural activities are mainly subsistence in nature and are highly constrained by weather conditions. However it is important to note that the poor and rich households draw 77% and 22% respectively of their incomes from agriculture according to the survey. Irrigation potential along rivers has been only minimally exploited. With more use of these rivers, a lot of cultivation would be done to increase food production in the District thereby assuring food security.

Observation shows that the inhabitants of Kitui, especially those living in the dry lowlands, depend heavily on the natural resource base for their basic needs-food, energy, water, and housing over and above subsistence cropping. There seems to be a very close negative linkage between their well-being and their resource base.

Akong'a points out that Kitui is arid and semi arid these but these facts should not automatically make the district be classified as economically marginal since there is potential for increasing the production and productivity of livestock keeping and fruit growing. (Akong'a, 1985).

2.2.5 Livestock Production Activities

Due to the arid climate of the district, Kitui has high potential rangeland and has a carrying capacity of less than 4 hectares per stock unit[4]. The carrying capacity has been declining over time. According to GOK and UNICEF (1990), the most important livestock in numbers and values are goats. The dominant vegetation, the shrubs, makes it possible for goats to thrive. The other important animals are donkeys, which are mostly used for transportation. The traditional livestock breeds are still the most dominant breeds in the district (GOK and UNICEF, 1990). Majority of rural households keep cattle either for meat, milk, pulling carts and/or ploughing. The table below summarises livestock wealth in the old Kitui district as documented by CBS 1981/82 Rural Household Baseline Survey.

2.2.6 Food Availability

From the earliest oral and recorded history of the Kamba people of Kitui, it is evident that they have experienced cycles of droughts and consequent famines arising from acute water and food shortages. Famine does not therefore only refer to acute shortages of food but also of water for human and livestock (Akong'a 1982; Kisovi, 1989). The recurrence of droughts and famines has been institutionalised since some people's names; age sets and other major historical events are marked by reference to unforgettable past droughts and famines. This way memories of specific famines are kept alive.

Owing to the unreliability of rainfall, population pressure, poor methods of farming and of storage of agricultural produce, famines have intensified in many parts of parts of Kitui. The District normally experiences food deficit due to recurrent drought episodes (Republic of Kenya, 1997).

The little harvest made is supplemented by seasonal relief food from donor agencies. To avail food to the majority of the population, there is need to improve water supply in the district so that food production can be increased. The need is urgent.

2.2.7. Community Organisation For Development

The Evolving Traditional Form

Traditionally institutions among the Akamba were organised for the purpose of benefiting the society (Ndeti, 1972; Muthiani 1973. The social structure of Kitui people is non-centralised with clans being used as mutual aid societies. The clans also act as mechanisms of social control among their members (O'Leary, 1984, Akong'a et al, 1986; Mutiso, 1977). The clans help their members in certain productive work such as clearing land, harvesting weeding or building a house. Clan members form a self-help group *(Myethya)* to carry out such duties (KIDP, 1992).

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[4] Carrying capacity- a stock unit is a standardized animal unit by which animals of different ages, types or species are compared (Pratt and Gwayne, 1977)

Table 2.0: Inventory of Livestock by Type and Grade Owned and Kept on Shambas

	Number (000's)	Value (000 Ksh.)
Zebu Cows	121.1	5,430.7
Zebu Heifers	61.7	2,003.7
Zebu Calves	51.5	1,102.1
Cross Breed Cows	1.5	41.1
Crossbred Heifers	2.2	64.7
Crossbred Calves	0.4	2.0
Grade Heifers	-	-
Grade Calves	0.8	44.1
Steers	-	-
Oxen	9.2	476.6
Breed Bulls	48.2	1,920.0
Sheep Rams	48.2	2,167.9
Sheep Ewes	96.2	8,867.5
Goats Males	177.2	19,841.7
Goats Females	439.4	52,241.8
Donkeys	35.4	27,899.0
Pigs	-	-
Poultry	671.8	7,783.5
Bee Hives	96.5	2,626.2
Other	18.2	1,767.6

Source: Republic of Kenya (CBS), RHBS, 1981/82

Mutiso (1994) notes that *Myethya* groups were traditionally mutual aid institutions but have today been transformed into self-help groups. Akong'a et al (1986) say that the traditional mode of production on *Myethya* group basis has today been modified and extended to take care of a broader range of individual and social needs. The institutions are now working more on projects for general socio-economic development as well as for individual economic benefit. Many are not clan based unless the settlement pattern is essentially clan as in some areas.

The main activities performed traditionally by *Myethya* groups were weeding and harvesting on mutual grounds, assisting one another in constructing houses etc. Today, *Myethya* groups have been modified into self help-groups, which play the role of catalyst to community development. They are now recognised as the basic responsible units for identifying, planning and executing development projects in the community (KIDP 1992)

MAJOR FAMINES IN UKAMBANI

Name of Famine Episode	Year of Occurrence
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 Maalakwe*
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 locusts attacks
1942	A great famine known as *Yua ya Mwanga* that extended to central Kenya; many people relied on cassava for food
1944-47	Prolonged famine known as *Yua ya Ngie* 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 known as *Nikw'a Ngwete* because peoples' incomes were stable yet there was severe shortage of food
1992	Drought and famine
1997	Drought and famine

Source: Where there is No Water, SASOL and Maji na Ufanisi (1999) and Field Interviews

According to KIDP (1992) the problems that face various groups in Kitui District include: lack of resources, poor planning and leadership, poor management of available resources, marketing problems in cases of those involved in income generating activities, lack of technical know how, lack of technical assistance, lack of adequate rainfall and scarcity of water, poor infrastructure, lack of credit facilities, lack of professional advice, inability to organise meetings efficiently, among others. It is possible utilising participatory processes in development can solve some of these problems.

Participatory Development

The concept of participatory development has been surrounded by controversies. Scholars from different academic backgrounds and orientations define the concept differently but there seems to be a consensus on that it must be geared towards benefiting human beings as perceived in a specific self defined community. Stemming from this then, of central importance is who actually moves activities.

Participatory development can be seen as a process of change in a community, which employs local as well as external resources. It is dynamic, continuous and is based in a community made up of individuals. Each community has a wealth of resources at its disposal at any point in time, which can be supplemented with external resources in initiating the process. The human resources are paramount in this process.

Communities do not exist in a vacuum for they interact with one another and as a result of these interactions; ideas and information and new knowledge are constantly being added to the body of historical knowledge.

A community is made up of individuals. Most of these individuals exist in harmony with the prevailing social and physical conditions. A very small number of restless individuals however have an extra edge above the others. Amongst these few one finds individuals with different characteristics.

First, are the custodians: who establish the community behavioural norms. They incorporate or reject new influences. Second, are the problem solvers whose ability ensures the survival of a community in the face of adversity. Third, are the information gatherers who seek information for its own sake and know everything in the community. Fourth, are the brokers who use knowledge, influence and organizational ability to get things done.

It is apparent therefore, that, a community will develop at a pace proportional to the effectiveness of its internal leaders whose vision; leadership skills and abilities propel it forward. This is indicated in the following cases drawn from SASOL's experience in central Kitui over the past ten years.

First, a community custodian who is a councillor has been instrumental in supporting his community in construction of sand dams in his location. His vision of the benefits of water for the development of the area was the driving force. He influenced the community to undertake the construction work of the dams. His participation in the project ranged from involvement in the work at all sites and monetary contribution. Above all, during the implementation of the project, he invested his energies in teaching the people the importance of water, showing them the options it is going to open for them. Thus he urged the people to invest in the future of the community.

The second case is of a chief, a problem solver, who spearheaded the project in his area. As a chief of a location, one is in-charge of all the development projects in the area. However, not every Chief has the initiative to bring change in his/her area. This chief, being well versed in the problem of his community, has been keen to look for opportunities for solving them. At the start of the sand dam project, the major problem was limited visualization of the potential of the sand dams. Secondly, the community realised that the project involved heavy manual work. The chief helped the community in visualizing their land with water. This chief was also instrumental in persuading the people to grasp the opportunity and help themselves by investing in water for future use. After completing the first few sand dams, people saw the results. They were motivated to continue with the project

The third case is that of a broker, who is also an information gatherer. This person being an information gatherer became aware of the sand dams project immediately it was started in a nearby location. The person visited and studied the project being undertaken with members of that community. The person also learned that the project would extend eventually to his community. Bidding his time and covertly checking when their area would be covered, this person started preparing the community for the project. During this process, he utilized his organizational skills and community knowledge to build up a structure of implementing the project. The rate at which the project was implemented in his community is amazing. It took only a quarter of the time used by other communities to build a dam in this community.

Box 5 Kyangunga: The Pushed Become The Pusher

Kyangunga sub location is the southeastern most sub location of Mulango location in Kitui district. It is one of the four sub locations. It has a population of 500 households. The major economic activities in the area, before SASOL started working there, were subsistence crop agriculture coupled with limited livestock keeping. The main crops were maize, cowpeas, beans and pigeon peas.

The rainfall is estimated as about 600mm per year. It is erratic and comes in short storms. Given the limited and erratic rainfall, which is coupled with high runoff as well as high evaporation, there is limited available moisture for crop agriculture. Consequently drought and famine are endemic.

The drainage system comprises of three seasonal streams namely Nzeeu, Kiindu and Nduni. Runoff is high for the land is undulating, has scanty ground cover and farmlands and grazing lands are un-conserved. The riverbeds run dry after about a month. There is ample sand in the riverbeds given the high rate of erosion in the area.

Residents of Kyangunga have been constant recipients of food for their production is not sufficient. This is usually delivered through food for work by either government, NGOs, churches or politicians. They show dependency on outsiders and have allowed the traditional community organisations to atrophy over time. They have been captives of the ***NO FOOD NO DEVELOPMENT PROJECT SYNDROME.*** This led them to being pushed with food so as to undertake their own development. Characteristically, the food donors identified the projects. The community therefore was at the mercy of the relievers. There were no releasers working with them for those who suffer community anomie are dependants addicted to the relievers.

There was very little community mobilization and planning for development projects of choice before the onset of the SASOL project. When SASOL started discussing the possibility of building sand dams in the community in 1995, the community insisted on being paid in kind- preferably food. Since the sand dam project strategy called for community participation and management, the onset and implementation of the project was very slow. The provincial administration ultimately got so embarrassed by the lack of cooperation by members of the community that they begun to mobilise/compel people to take part in the construction for they understood that the community could be left out of the construction if attendance at construction sites continued to be low. Leadership of the sand dams committees was problematic. When the community was asked to identify community people to be trained in natural resource management and leadership, it was expected that 70 persons would attend. It turned out that less than half of those identified ultimately attended the training Attendance at construction sites was very poor. There are dam sites where on average only 2-5 people showed up most days even though daily attendance per dam had been projected at above 50 people per day. The fact that sand dams would lead to improving food security through growing of vegetables for consumption and market over and above enabling tree nurseries for desired trees and the market as well as providing water for households and livestock was not enough to mobilise the people of Kyangunga.

Kyangunga perceives itself as the underdeveloped orphan of Mulango location. It is true that it is less educated than the sub locations, which are to its west and near Kitui town. It was in the western part of the location, near Kitui town, where education came first. As a result, most of the key local and national notables -teachers, preachers, tax gatherers, politicians, traders and provincial administration people come from that area. Kyangunga people argue that the other parts of the location as a result of historical disadvantages have dominated them. This argument may be socio-economically objective but it does not address the natural resources aspect for there is more land per capita in Kyangunga than in the Mulango areas near the town. It also is arguable that the soils in Kyangunga have more potential than in the crowded peri-urban area of the location.

Ultimately the dams were completed. For seven years, they languished without their potential for impacting on food security being utilized at all. People only drew water from the dams. Most of the time people ignored using the wells provided at dam sites. Cattle roamed over the dams for the river channel was the cattle road. The publicly zoned roads had been fenced. Nobody wanted to address the issue of damage to the dam s and river as a result of cattle trekking. People washed themselves and their clothes within the dams. These facts were documented in great detail in the in 2001 when the social economic study field workers were in the field. External people were treated to very hostile reception in this community, which seemed to have inexhaustible sources of local liquor. During field interviews, it was significant that out of every ten interviewees, more than three quarters –both men and women- were always drunk. The local leaders were as much involved in this as everybody else. Interviews were done all day long and some women complained than in this community most men did no work other than drink. The field workers

had direct experience of this when they had to drag local officials from illegal brewing drinking sessions at times as early as eight o'clock in the morning

In community development theory, the issue of drivers of community change is handled in unsatisfactory ways with regard to identifying triggers, contexts and approaches. We therefore will not present and evaluate the conflicting conclusions on this in this short box. What we want to present is the impact of one of the Kyangunga sons becoming the location Chief and raise questions towards thinking about the transformation of Kyangunga in less than a year.

When SASOL returned to the community to train on Sanitation, in 2002, they found that the person who had been an assistant chief- in charge of the sublocation- had been promoted to become the Mulango location chief. As sub chief, he had been caught in the web of the anomic social relations driven by dependency obtaining in the sub location as documented during the study in 2001. He had little time for the researchers then. Neither was he worried about the community deviant behavior with regard to ignoring the health and production potential of the dams. One community leader was openly agitating that he should be fired as sub chief for he was part and parcel of the community anomie.

Being appointed Chief seems to have been a trigger of change for the former sub chief. He has reduced local liquor drinking during working hours. He has mobilized the community to start vegetable growing. He is pushing for dam protection, which includes planting napier grass and keeping cattle out of the river. When he was approached by SASOL on the community sanitation training, not only was he enthusiastic about it but also offered to open the training himself. He personally and on behalf of the community apologized to SASOL for having participated inadequately in the building of the dams and not having utilized the dams until this year. He pushed his community to get aggressive for the things to be taught were clearly to be for their benefit. He also emphasized the need to coordinate what the community was to do not only in terms of sanitation but also about development specifically emphasizing conservation of community natural resources.

64 participants, selected by the community, attended the sanitation training. Not only did they attend faithfully but confessed that they have now realized the importance of the sand dams in terms of enabling them to diversify their production. They also said that they now recognize the importance of working together. They are also aware now that knowledge from outside can be useful to them in their planning long term development of their community and thus they know they do not need to be overly suspicious of all foreigners.

Why have this community of the pushed become pushers? Is the chief the trigger for the community? In turn what triggered him? What is the source of the new hope found in this community? Is it going to stay the course? It is true Chiefs have been significant actors in mobilizing communities to do what is essential for their own sustainable development. However, why would they change so rapidly after seven years of ignoring the use of the dams remains a question in our minds.

We will be reporting on Kyangunga from time to time. Stay tuned.

According to Pinstrup-Andersen et al (2001), empowering poor rural women with adequate water rights means strengthening their access to for both domestic and income-generating uses. Better access to water improves women's health and incomes and liberates from daily drudgery of fetching water. Income generation through gardening and farming, livestock, aquaculture, forestry constitutes the mainstay rural livelihoods, but women's opportunities for water-based income generation are still too limited. Further improved access to water can be negotiated relatively easily when new sources are developed. Women need to obtain an appropriate portion of larger supplies of water. However, when the available water sources remain the same, competition for water risks is harsh.

Worldwide, growing populations with higher living standards are making ever-greater claims on finite fresh water resources for agricultural, domestic, industrial, and other uses. In an increasing number of river basins, the physical limits of available water resources are being reached whilst pollution deteriorates water quality. Marginalized water users, especially poor women, risk

losing even the limited access to water that they now have. Growing absolute water scarcity and pollution hit poor women hardest (IFRI, ibid).

According to Akong'a et al (1986), in Kitui, rural women tend to dominate all sectors of community life and as a result, women are overworked. There is therefore need to reduce the workload of women by, for example, reducing the distance to water sources. There also is need to ensure that they get into the management of the resource.

2.4 Assessing Costs And Benefits Of Water Provision

While billions of dollars are invested every year in water projects in developing countries, only rarely are these investments subjected to serious social and economic analysis. A review of the existing literature on the economic aspect of water supply improvements suggests that surprisingly little empirical work has been done on the subject (Whittington 1992, Kamminga, 1991). The introduction of improved water supply not only generates benefits for the community members but costs too. The costs are incurred over a long period of time from the planning, implementation, and maintenance.

Some of these costs include the provision of labour and materials for construction; time invested in community organisation and management activities, training and construction; the reduction of employment opportunities in water vending, water carrying and well digging; increased inequality and conflicts among users. The benefits are realized after the completion of the project. These may include reduced distance in search of water; increased time availability for other activities; increased water availability; improved health; and reduced risks resulting from some water sources, for example deep sand wells (scoop-holes).

However, no attempt has been made to quantify these costs and benefits (Kamminga, 1991). Given that investment resources are becoming limited, more attention should be focused on cost/benefit analysis of water projects in a bid to make intelligent choices on technology; to assess the level of service; and to consider avenues of pricing and setting user charges. This will ensure maximum utilization of the limited resources available for the water supply systems development.

3.0 METHODOLOGICAL CONSIDERATIONS

3.1 ANALYTICAL FRAMEWORK[6]

Studying benefits means identifying causal relationships. This study analyses the social and economic impact of sand dams in Kitui district. To carry out this exercise, an analytical framework, developed by International Water and Sanitation Centre, in Holland, is adapted to suit the study area.

The model below shows the steps, which were followed in assessing the economic and social benefits derived from the sand dam project and to analyse the influencing factors. It must be noted that factors of influence are partly project related and partly related to the local conditions and dynamics. To bring this idea into perspective, the study area is divided into four catchments representing different ecological zones for analytical purposes.

A distinction is made between immediate effects on the resource base of communities and the ultimate impact on income levels of communities. For example, possible effects on the resource base are increased availability of time, human labour (energy) and production water. These gains can have potential impact on social and economic outputs in terms of increased productivity, income, well-being of the households and/or water collectors, etc. through the devotion of time and energy saving and use of more water in production.

STEP A is concerned with project planning and design. The following questions are raised. What are the project goals? Are the economic and social needs of the target group taken into consideration? In addition, are health problems considered? Are economic opportunities identified? To what extent will accessibility, quantity, and reliability of the water supply be improved? Is multiple water use included in the system design (construction; source yield etc.)? Are auxiliary inputs planned to support and promote income generation (that is, credit schemes, skills training, marketing promotion)? What are the expected outputs?

STEP B deals with implementation processes. The following questions are raised and assessed. Have the facilities been installed according to the set goals? Has accessibility and quantity of water been improved according to the plans? Have the auxiliary programmes been executed as planned?

STEP C is concerned with the functioning and utilisation of water facilities. Consequently, the following issues are raised. Are the water supply facilities utilized in such a way that benefits can be obtained and sustained in the short and/or long term?

STEP D assesses whether immediate economic benefits occur, and if so, to what extent. Answering the following questions does this. How much time and energy are saved and how much has access to water for production purposes been improved? How is access and control over these extra resources distributed?

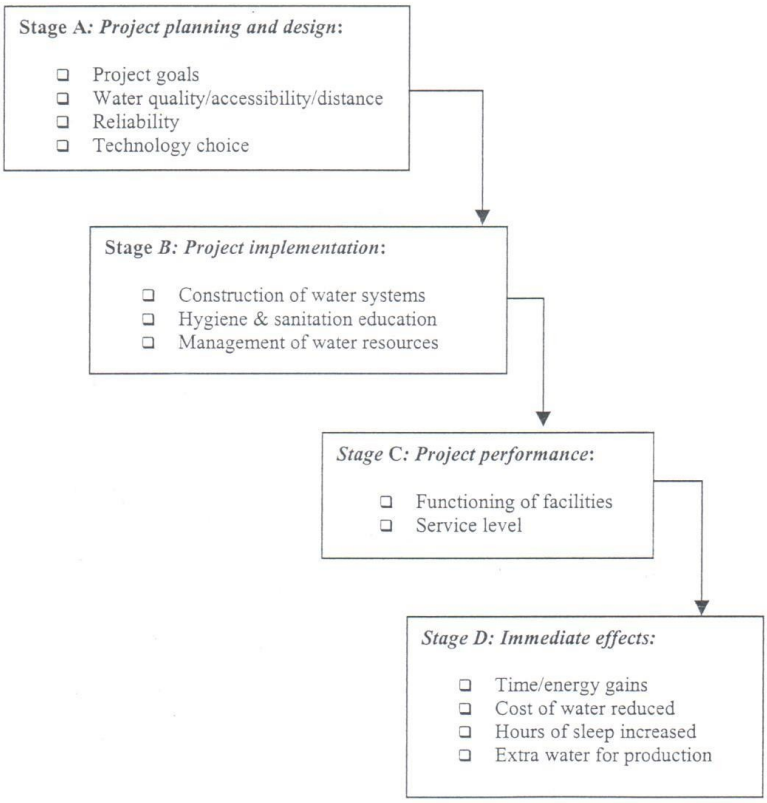
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[6] This section draws literature from Kamminga (1991). Useful comments guiding the analytical framework were received from Christine Van Wijk, Senior Researcher at IRC, Delft, The Netherlands

STEP E is concerned about measuring of the ultimate (long-term) impact. The following questions lead to clarification of this. Have economic and/or social conditions improved? Have the extra resources been used to increase productivity and incomes, or are they being used for social purposes? How much income is being generated? Are there any negative social, economic, technological or environmental impacts?

Finally, data on positive and negative changes (spin offs) occurring as a result of the implementation of the project will be analysed. One has to note here that such changes might not be noticeable immediately but after a number of years. Positive changes could be: the position of women has improved; overall ability and willingness to pay for water fees has increased; users feel more motivated to participate in community project management; sustainability increased, etc. Possible negative changes are increase of women's workload, environmental degradation around the water sources, etc.

Figure 1: Graphic Analytical Framework



3.2 RESEARCH DESIGN

How can one really establish whether economic and social benefits result from the installation of an improved water supply system (IWSS), for example, construction of sand dams? To establish a causal relationship between the construction of sand dams and social and economic benefits to households in the community where the project took place we adopt the design developed by Whittington (1992).

But before we begin our discussion on the various approaches to this design, it is important to have a clear sense of how one can be confident that a causal relationship exists between the installation of an IWSS and any kind of hypothesized effects or consequences e.g. Time savings, shortened distance, increased water consumption etc. The Research attempts to make valid inferences about causal relationships by comparing data pertaining to the variables of interest from different situations so that the difference in the measured variables indicate the effect of the 'treatment' or 'intervention'.

In a laboratory experiment, the researcher attempts to administer a treatment to one group of subjects and not to a second group, called the 'control group'. By careful construction of the experiment, the researcher attempts to ensure that the only difference between the two groups is that one receives treatment and the other one does not. Any observed difference in the variables of interest can be attributed to the treatment.

One would wish this to happen in social science research. But this is not possible because the treatment takes place in actual communities where it is impossible to maintain strict control of research conditions. Whenever a water system is installed in real world situation, so many other things are taking place simultaneously and there is always a risk that the researcher may be tempted to arrive at a wrong conclusion.

Three research designs to establish the causal relationships between IWSS interventions and hypothesized effects are discussed below. To illustrate the application of these designs, we define the following notational system.

Let

SD = a treatment- in our case construction of the sand dams
O_t = observation of the phenomenon of interest where subscript (t) indicates the period of recording of the observation.

3.2.1 Untreated Control Group With Post-Test Only (Cross-Sectional Design)

The design can be illustrated as follows:

SD O_1 *(Treatment group)*
O_1 *(Control group)*

Here the researcher evaluates the situation only after the improved water supply system (SD) is installed. The researcher attempts to identify communities or villages without an improved water system that are like the treatment communities were before the installation of the improved water

system. Any difference between the observations (O_1) in the treatment and control groups is ascribed to the effect of the improved water system (SD).

The primary threat to the validity of this design is the absence of any pre-test data. Although researchers attempt to select samples for the control group that are equivalent to the treatment group, this is generally very hard to find in field settings. For example, the environmental or socio-economic conditions of the treatment and the control group may differ. It is also worth noting that this approach is expensive and financially beyond the scope of small research efforts.

3.2.2 Pre-Test/Post-Test Design (Time-Series Design)

This can be represented as follows:

O_1 SD O_2

The pre-test observations (O_1) are recorded on a single group of individuals (there is no control group). After these individuals receive improved water system (SD, the researcher returns to measure the post-test observation (O_2). The two sets of observations are compared, and any difference is attributed to the treatment. The main threat to the validity of this design is that some other change will occur in the community besides the installation of the improved water system. This extraneous factor could either cause the change in the measured effect (and the researcher would wrongly conclude that the change was the consequence of the IWSS) or cancel out the effect of the improved water system (and the researcher would incorrectly conclude that the improved water system had had no effect). Thus, a control group is required to minimize such risks.

3.2.3 Untreated Control Group With Pre-Test And Post-Test (Time-Series Design)

The third design combines the strengths of the previous two designs. The design can be illustrated as follows:

O_1 SD O_2 *(treatment group)*
O_1 O_2 *(control group)*

Here, both the treatment and control groups are identified and observations of both are made before and after the treatment is administered. From the baseline data it should be possible to verify that there are no statistical differences between the treatment and control groups before the IWSS is installed. Observations are also made of both experimental groups after the treatment. If the observations (O_1 and O_2) for the control group remain unchanged and observations for the treatment group change, then one can generally be confident that the difference between O_1 and O_2 for the treatment group is due to the improved water system. This is the strongest design, though extremely expensive to implement.

3.2.4 Choice Of Study Design

No baseline survey was carried out before the construction of the sand dams in the project area for donors were not willing to give development as opposed to research funds. Therefore none of the three designs could be applied alone in the project area. The researchers came up with a compound design with components derived from the above designs. This basically involved

comparing water collection and water use patterns of the community with a nearby community without an improved water supply.

This is illustrated as follows:

O_{2r}	SD	O_2	*(treatment)*
		O_1	*(control)*

Here the researchers evaluated the situation only after the construction of the sand dams. The observed variables of interest after the treatment (SD) are denoted as O_2 for the treated group. Respondents were asked to report, based on the strength of their memories, how the variables of interest were before the treatment. This is denoted as O_{2r} . A control group (baseline survey- Yatta and Mutomo Division), derived from communities thought to be similar to the treated group before the treatment was identified and observations of the variables of interest (O_1) recorded. Differences before and after the treatment SD were noted and analysed. The situation before the treatment O_{2r} was compared with O_1. Where O_{2r} and O_1 were found to similar, then the difference between O_2 and O_{2r} were associated with the treatment (SD). The results were interpreted with a lot of caution.

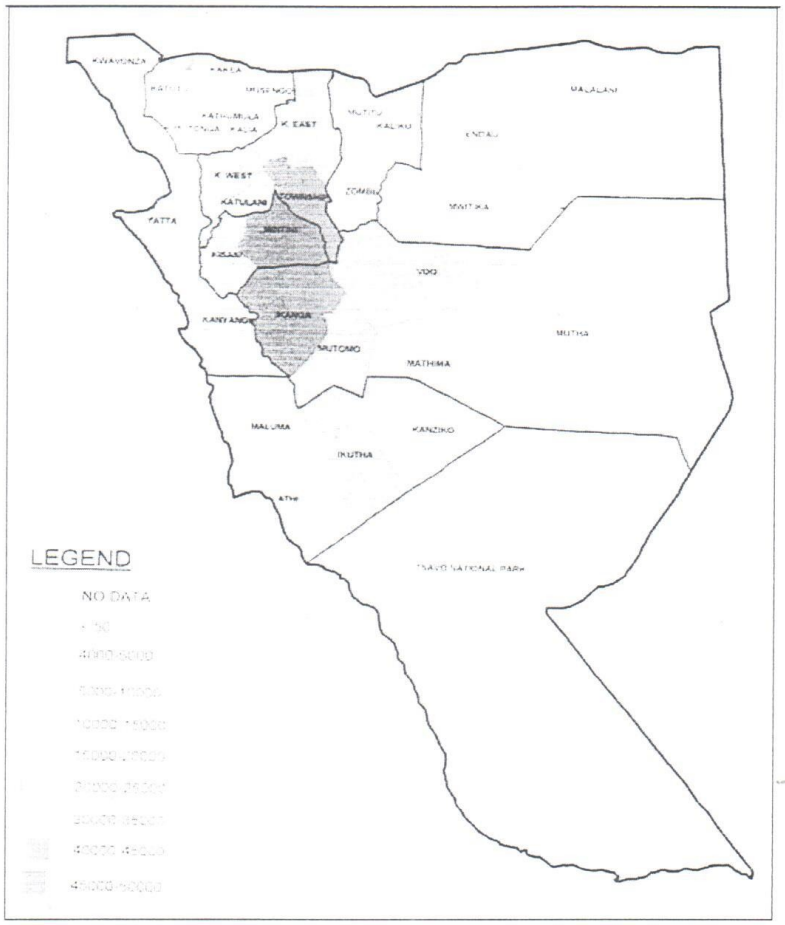
In this case, sampled households in the project area (Central and Chuluni Divisions) were asked questions describing some variable of interest (e.g. distance to water sources, time taken, number of trips, sanitation, soil conservation, management of water projects etc) before and after the implementation of the sand dams project. These observations are labelled O_{2r} and O_2 respectively in our study model. Another sample from where the project had not been implemented was interviewed in Central and Chuluni divisions (non-participants) and in Yatta and Mutomo divisions (baseline). Observation from this group is labelled O_1 in our study design.

3.3 SAMPLE FRAME, SAMPLING PROCEDURE AND DATA COLLECTION

3.3.1 Sample Frame

In developing the sample frame, data from the 1999 National Census was used. The sample frame was participants (those individuals who took part in the construction of the sand dams), dam committee members (individuals who were nominated, selected or elected to take up leadership in the construction and management of the sand dams) and non-participating- baseline (individuals living in the same sub-location who did not take part in the project or living in other sub-locations where the project has not been implemented) households in Central, Chuluni, Yatta and Mutomo (old Mutomo which included Ikutha divisions) in Kitui District.

MAP 4: Kitui Population Density



Source: 1999 National Population Census and Household Survey (Republic of Kenya, 1999)

Table 3.1: The Study Area Population And Number Of Households

Division	No. of Locations	No. S- Locations	No of Households (HH)	Sample size (10% of HH)
Yatta	3	8	7,648	765
Central	8	30	20,683	2,068
Chuluni	5	15	12,977	1,298
Mutomo[7]	16	57	24,325	2,433
Sub-total	32	110	65,633	6,564

Table 3.2: Dam Committee Members Sample

Catchment	No. of Dams	No. of Committee members	Sample size (10%)
Kiindu	40	520	52
Kisiio	30	390	39
Mwiiwe	55	715	72
Ithumula	34	442	44
Other catchments	41	533	53
Total	200	2,600	260

3.3.2 Sampling Procedure

This study drew data from sampled households of both participants and non-participants in the project area.

A representative number of households (10% of the total number of households) were sampled using stratified random sampling technique weighted by the total number of households obtained from the 1999 National Census.

Dam committee members where categorised according to the river catchments where the dams are found. Ten percent of dam committee members from all the catchment were sampled and interviewed using open and closed-ended questionnaires.

The tenth household[8] on either side of the numerous paths leading from the local trading centres in every sub-location was sampled and interviewed. For the purpose of obtaining a comprehensive picture of social and economic impact of the sand dams, inter-method triangulation (application of both qualitative and quantitative methods in data collection) approach was adopted in analysis.

3.4 SURVEY INSTRUMENTS AND DATA ANALYSIS

3.4.1 Survey Instruments

The construction of the survey instrument was done in four stages. First was a desk study on all past research in the project area. Data on local production, collected by community groups, were analysed. This information aided in shaping up the research tools. In the second stage, field enumerators collected data from the sampled households in the study area administered questionnaires. The principal researchers trained the enumerators for two days and supervised them while in the field. They further held discussions with key informants in the study area. Casual observation also formed a very important research tool in this study.

3.4.2 Data Analysis

There are various methods of measuring the relationships existing between variables. In this study data analysis was limited to frequency table analysis, correlation tests as well as minimal econometric regression analysis. These yielded both simple, easy to understand descriptive and inferential statistics used in making predictions and conclusions necessary to answer the study

[7] This is old Mutomo Division, which includes the current Ikutha and Mutha Divisions.
[8] A household was defined as a group of people who worked together on plots of land and cooked and fed together during meal times.

questions. Data from various variables was grouped into classes with reasonable class width for easy interpretation.

The analysis is based on three categories of respondents. The first category comprises of the people who participated in the construction of the sand dams- referred to as *Participants*. This category of respondents is further divided into three catchments namely Kiindu, Wii and Ithumula. The underlying assumption is that these were the first areas to be built thus the impact of the dams is expected to be elaborate. From casual observation, these catchment present variations in terms of levels of utilization of the availed water, community organization, and belong to different agro-ecological zones. Wii catchment is dry and levels of utilizations are relatively high. Comparably, Kiindu catchment agricultural potential high and has more water availed while the utilization levels are seemingly low. Social organization in the lower Kiindu (around Kyangunga Sub-location) portrays aspects of social decay and presented problems in community mobilization during the construction. Ithumula catchment presents a different social and economic phenomenon. This is a highly individualistic community. It posses high agricultural potential and levels of water utilization are high. These catchments are compared and contrasted for they have presented specific problems in implementation. It is hypothesised that the peculiar socio-economic and perhaps physical characteristics of these catchments will determine how the communities in these catchments will use and sustain the water points. Global data is presented first and then data pertaining to specialised categories (the catchments and some sub-locations within the catchments and the baseline) is then presented. Data from the participants was also analysed on gender basis for some variables.

The second category comprises of community members within the project area who did not participate in the construction of the sand dams, otherwise referred to as the *Non-Participants* in this report. This was to identify the reasons behind their non-participations and the spill over effects from the project.

The third category is the baseline. This is the control group and the data is imperative for planning and evaluation after the implementation of the project in the area.

In the following chapters the outline presented in section 3.1 is followed. First, the households' demography and socio-economic status is outlined. Project performance and immediate effects are also discussed. The ultimate impact of the project and the impact of the training imparted on the dam committee members are evaluated.

To cover adequately issues of increased land output through sustainable agriculture is based on optimal use of local resources and natural processes and safe efficient use of external inputs is problematic where there is no historical data. To make sense out such a study one needs to know the types and amounts of agricultural crops and livestock produced under normal circumstances (rain-fed) before the intervention for at least five years, which is normal drought cycle. Since the cardinal (numerical) data of the land productivity before the project was not available, the researchers were forced to use ordinal analysis in tackling this issue. The data from District Ministry of Agriculture officials on productivity per unit of land is perceived to be nothing more but a guess-estimate.

To collect reliable productivity data, one needs to establish what is harvested, consumed while in the farm and what is eventually harvested, stored, given away, exchanged, or sold for a period of five years. Further, a such a study would call for a representative sample of at least 10% of the

total household population of the District with the instruments totally focused on this issue since farming systems of the District have not been studied.

Ordinal data on this issue was obtained using the questionnaire. Respondents were asked to report on the crop agriculture and livestock production before and after the project. It is recommended that a major study on land productivity be done in the future.

4.0 SAMPLE CHARACTERISTICS

4.1 HOUSEHOLD SIZE AND COMPOSITION

Kitui District has a mean household size of 5.1 persons per household (WMS II 1996). The household size and composition (males and females) affects labour distribution in situations where there is sharp division of labour based on gender. This has impact on implementation of community development projects.

Global data from the project area (participants) show that majority (76%) of the households had between 3 and 7 members, 22% had between 8 and 12 members while 2% of the households had more than 12 members. Data from the non-participants indicate that families with three members and below form 10% of the sample size while majority (68%) had between three and eight members. Twenty (20%) per cent of the families had between 8 and 12 members while only one percent had more than twelve members.

Similar findings were obtained from the project area participants. Families with between three and seven members formed the majority. It was recorded that 72%, 69% and 52% of the participants in Kiindu, Ithumula and Wii catchments respectively were fall in this category.

Most households in the baseline area had between 3 and 7 members (70% for Yatta and Mutomo). The second category in rank is that of households with between 8 and 12 members, 22% for Yatta and 22% for Mutomo. The category with the least percentage was that of households with below 3 members (7% for Yatta and 7% for Mutomo).

The composition of households is summarised in table 4.1. Among the participants (global), the number of families with more females than males or vice versa was equal (41%). Data from the non-participant respondents indicate that majority (42%) of the households had more females than males.

Table 4.1: Household Composition

	Non-participants (Global)	Participants (Global)	Ithumula	Wii	Kiindu	Yatta	Mutomo
Females=Males	23	18	21	8	24	21	27
Female more than males	42	41	41	44	38	31	35
Females less than males	35	41	38	48	38	48	37
Total	100	100	100	100	100	100	100

In Wii catchments the households with sex ratio 1:1 make 8% of the interviewed households, households with more females than males formed 44% of the sampled households while households with more males than females form 48% of the interviewed households. Kiindu and Ithumula catchments had patterns similar to Yatta and Mutomo as shown in the table 4.1.

In Yatta division, there were more males than females. This is expected due to predominance of *Syengo* where majority of those who take care of cattle and the farms are men. The people who reside in the cattle posts have homes elsewhere where the families reside.

Family size figures in the sample fall within the Kitui District average (5.1) and the national average of 5.2 persons. It has been observed that chances of finding families with equal number of females and males were minimal. Given that household size and composition does not have age connotation, the two variables may have little correlation to project participation.

4.2 HEAD OF THE HOUSEHOLDS' SEX

According to the Welfare Monitoring Survey II (WMS II) of 1996, 71% of households in Kitui district were male headed even though 53% of the entire population was female. However, according to the study findings, the level of female-headed households formed over 50% of the total on average in the study area. This has impact on the household human capital endowment. This sex disparity is traced to various reasons including men working outside the district, single parenthood and widowhood. Given the high frequency of drought, men move out of the district in search of employment opportunities. This leaves the burden of fending for the family with women.

Global data from both the participants and non-participants indicate that, 57% of the households were female headed.

Table 4.2: Head of the Households' Sex

Sex	Non-Participants	Participants	Kiindu	Wii	Ithumula	Yatta	Mutomo
Female	57	57	48	65	57	56	44
Male	43	43	52	35	43	44	56

Kiindu catchment data show that 48% of the participants are females. In Ithumula catchment, 57% of the participants are women while 65% of the participants in Wii are females. It logically translates that these women are heading their families.

Most households in Kyangunga sub-location (in Kiindu catchment) are female headed i.e. 65% of the participants and 65% non-participants. This is expected in Kyangunga owing to the existing social decay in the area i.e. traditional beer taking.

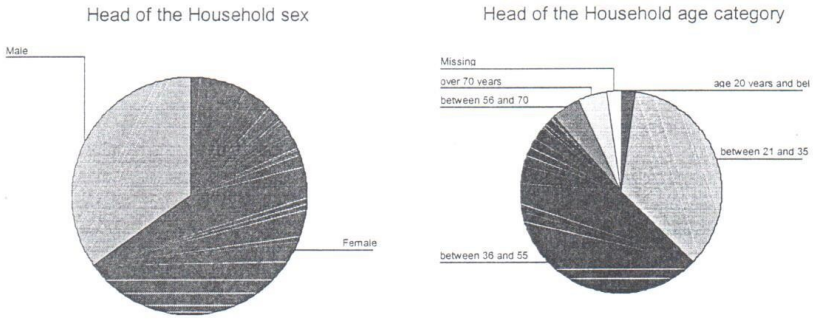
The global baseline data from Yatta division indicate that 56% of the households are female headed while 44% are male headed. Baseline data from Mutomo division show the opposite scenario, females form 44% of the household heads while males form 56%. Sometimes data for specific sub-locations show higher percentages of male household heads while the case is higher for females in others. However, the variations are not big. In Syomunyu (Yatta) for example, 57% of households are female headed while. Contrary to this, in Kathungu sub-location (Ikanga) 54% of the households are male headed.

The variations in household head ratios in various divisions and sub-locations can be traced to a number of reasons; difference in resource endowment. In areas where land is productive, chances of migration during famines are minimal while the rates of migration in areas, which are less endowed with resources, are high. The possibility of returning home after a famine incidence is high for people from areas with high resource endowment.

The implementation of sand dam technology involves both male and female labour. Availability of this labour affects the rate at which a dam is constructed. In cases where male labour is

required for breaking of rocks, more of male labour is required for satisfactory project implementation rate.

Figure 4.1: Kyangunga Sub-Location: Sex And Age Household Distribution



The above sex ratios need to be put into consideration while training project participants; where we have more males than females heading households, there is need for having more males than females in the management and vice versa. On the same line while setting up dam committees, the issue of gender balancing should be guided by the male-female ratio. Gender balance does not mean a ratio of one-to-one even in situations where members one sex outweighs the other.

4.3 HEAD OF THE HOUSEHOLDS' AGE

From the global project area data, 23% of the households were found to be headed by people whose age fall between 21 and 35 years, the category with the highest household heads is that of age 36 to 55 which forms 44% of the sample. Households headed by people aged between 56 and 70 were found to be 29% of the interviewed participant households while 4% of the households are more than 70 years old.

During the interview a case of a 16-year-old girl who heads a family was encountered in Kamale village in Ithumula/Maluma sub-location! The husband was found to be 19 years old! This is a child to adult marriage.

Global non-participant data indicate that 3% of the households heads are aged 20 years and below. People aged between 21 and 35 years head thirty (30) per cent of the households. The majority of the households (49%) are headed by people between 36 and 55 years. Those in 56-70-age bracket head fifteen (15) per cent. People who are over seventy years of age head only 3% of the households.

Data from Ithumula catchment indicate that 26% of the Household heads (participants) are aged between 21 and 35 years, 46% fall within the 35-55 age bracket while the rest (28%) are aged between 56 and 70 years. In Wii catchment, 32% of the interviewed participants fall within the 21-35-age category, 40% fall in the age bracket 35-55 years. Those in the age category 56-70 form 20% of the sample while 8% are more than 70 years old. The age distribution of the household heads in Kiindu is shown in table 4.3.

Table 4.3: Heads of Household Age Bracket

Class	Non-participants	Participants	Ithumula	Wii	Kiindu	Yatta	Mutomo
20 years and below	3	0	0	0	0	3	1
21-35 years	30	23	26	32	10	31	32
36-55 Years	49	44	46	40	48	52	46
56-70 Years	15	29	28	20	38	12	17
Over 70 years	3	4	0	8	4	2	4

In Yatta division, 3% of the household heads are either 20 years old or below. Those who fall within 21 to 35 years age bracket form 31% of those interviewed. Majority (52%) of the household heads are between 36 and 55 years. Twelve (12) per cent of the household heads fall within 56 to 70-age category while over 70 years are from the minority. The data indicate that majority of the household heads in Yatta division are middle-aged people. In Mutomo division, those between 36 and 55 years, head the majority (46%) of the households. This data shows that majority of the households are headed by people who are middle aged (35-55 age bracket). The middle aged are responsible, active and strong enough to participate in the projects. This distribution also means that chances of tapping educated leadership are high owing to the fact that majority of those aged below 35 years have at least attained primary education and chances of having participants (especially those aged between 21 and 35 years) who have attained form four education are high. From an economic point of view, this age distribution means that the participants are able/will be able to make use of the availed water for production purposes.

4.4 HEAD OF THE HOUSEHOLDS' LEVEL OF EDUCATION

Literacy levels affect implementation and management of community development projects. Even though high literacy levels are associated with project success on one hand, in some cases it can act as cause of project failure on the other. The later outcome results where there are sharp divisions and differences resulting into conflicts between the literate and the illiterate as it has happened in Kitui historically.

In 1988, 50% of the residents in Kitui district could read and write. Of these, about, 71% were capable of writing in at least one language 28% could do so only partially while 1% could not do so at all. This is critical because less than half of the district's population had the ability to read and write (GOK and UNICEF, 1990).

Overall data from the sample shows that the average highest level of education attained was primary school level. The details are presented in table 4.4.

Kiindu catchment data show clearly that most of the participants had attained either primary or secondary school education. The level of participation in community development committees is high for those with primary education, not the informally educated or the highly educated. The findings are summarised in table 4.4. **Perhaps this reflects the self-sufficiency of the highly educated and the poverty of the informally educated.**

Table 4.4: Highest Level of Education Attained by Household Head

	Non-participants	Participants	Wii	Ithumula	Kiindu	Yatta	Mutomo
Informal	29	29	16	36	36	23	31
Primary	48	46	44	51	44	57	53
Secondary	18	22	36	10	20	17	14
Tertiary	5	2	4	3	0	3	2

In Kyangunga sub-location (in Kiindu catchment), most of the household heads had either informal or primary level education (40% participants, 41% non-participants)

In Wii catchment, the situation is different, its only 16% of the participants who had informal education. For non-participants, the percentage is quite high, 50% (primary education). Data for Ithumula catchment is shown in the table (4.4).

In Ithumula/Maluma Sub-location (in Ithumula catchment), more than half of the participants had acquired primary education and 39% had informal education. For non-participants, 23% of those interviewed had informal education and 60% had acquired primary education. 11% of the participants had secondary education while 19% had an opportunity of going up to secondary school level. A very small percentage (1%) of participants had studied up to tertiary level and none of the non-participants had attained tertiary education.

The literacy levels for Yatta division are similar to those of the project area. Twenty-three (23) per cent of the interviewed household heads had informal education, 57% have acquired primary education and 17% had attained secondary education while 3% had gone up to the tertiary level.

The above figures imply that the literacy levels in Yatta, like many other parts of Kitui district, are low i.e. 80% of the respondents had informal and primary level of education.

Literacy levels in a community play a key role in determining the rate at which community members adopt new technologies. It easier for a more educated population to understand the benefits they are bound to reap from adoption of a particular technology. High literacy levels may imply more sound community dam management teams in terms of administration, information gathering, and marketing of produce resulting from the project. In future this may not be an obstacle to realisation of the full potential of the benefits resulting from the availed water.

5.0 HOUSEHOLD ECONOMIC CHARACTERISTICS

5.1 LAND OWNERSHIP AND USE

On average, data from Yatta and Mutomo divisions indicate that the average land ownership was higher than the district average. In 1981/82, the mean holding size was 8.7 acres (GOK and UNICEF, 1990). Over 40% of the respondents own more the ten acres of land. On average, 32% possess between 5 and 10 acres. Only 24% own less than five acres of land in the baseline area. Renting land for production purpose was established to be minimal in these two regions. For example, only one percent of the respondents from Yatta division had rented land from others for production reasons.

In the three catchments, the size of land owned was small compared to the baseline area (Mutomo and Yatta). In Wii and Kiindu catchments 72% and 48% of the participants respectively, own less than five acres of land. Similarly, 62% of participants in Ithumula own the same size of land.

The land use patterns in the study area are presented in the table 5.1. While Yatta division is classified as a ranching zone (GOK 1997, GOK and UNICEF 1990), the results from the survey are to the contrary (see the table 5.1). The size of land devoted to crop farming was above 60% on average in the sample frame. For example, in Yatta and Mutomo divisions, 64% and 58% respectively, of the total land owned was engaged in agriculture as the main use. Livestock keeping constituted the second land use in the study area. The scenario was similar in the catchment areas, with 84% and 82% of the interviewed participants in Wii and Kiindu respectively using their land resource for crop farming. In Ithumula, crop farming occupied 74% of the participant's devoted land.

Table 5.1: Main Land Use

Main Land Use	Non-Participants	Participants	Wii	Kiindu	Ithumula	Yatta	Mutomo
Agriculture	80	85	84	82	74	64	58
Livestock	15	7	8	18	18	27	41
Homestead	3	7	4	0	5	9	1
Other	2	1	4	0	3	0	0
Total	100	100	100	100	100	100	100

Much of the land in the project area was devoted to subsistence farming. Livestock keeping occupied the second position. In Mutomo and Yatta Divisions, it was established that due to low population density and presence of cattle posts, the amount of land committed to livestock farming was relatively large in size compared to the rest of the area under study.

5.2 SOURCES OF INCOME

5.2.1 Head of Households' Occupation

Dry land farming is practised in Kitui district as dictated by the arid and semi-arid climatic conditions. Agricultural activities are mainly subsistence in nature and are highly constrained by weather conditions. However, it is important to note that the better off households draw 77% of

their incomes from agriculture (GOK, 1997). The major food crops grown in the district include maize, beans, cows-peas, cassava, green grams and millet. Among the cash crops grown in the district are cotton, mangoes, pawpaws, bananas and citrus fruits. Others include tobacco mainly in Central and Chuluni divisions and coffee in Central and Kabati divisions. However these crops are grown on small scale.

Vegetables such as Karrella, Brinjals, Okra, Tulia Tinda, Tindori and chillies are grown under irrigation along Athi River in Mutomo division. Other Local vegetables such as tomatoes, cabbages, kales, spinach, onions and capsicums are grown are under rain fed conditions district-wide.

In the project area, most (71%) participants were found to be farmers, 8% were business men, 8% were wage earners, 7% were found to be engaged in wage employment while 3% were engaged in other activities. On average, over 60% of the sample (in all the four categories-participants, non-participants and dam committee members in the study area as well as the baseline area) were subsistence farmers. Majority of them depended on rain-fed agriculture. For example in Mutomo and Yatta Divisions, 78% and 77% of the respondents were engaged in subsistence agriculture. The rest were engaged in regular and wage employment and business as their main occupations. Owing to the fact that out of every three seasons one is a failure, water becomes a very useful resource to most of the farmers.

In Wii and Kiindu catchment 76% and 98% of the participants reported subsistence agriculture as their main occupation. In Ithumula catchment 92% of the participants rely on agriculture too.

Table 5.2: Head Of Households' Main Occupation

Occupation	Non-Participants	Participants (Global)	Wii Catchment	Kiindu Catchment	Ithumula Catchment	Yatta Division	Mutomo Division
Farmer	80	89	76	98	92	78	77
Regular employment	3	2	4	2	0	10	7
Business	7	4	8	0	5	3	8
Wage earner	6	5	12	0	3	7	6
Other	4	0	0	0	0	2	2

It is important to note the diminishing role of livestock keeping as occupation and a prime source of income as show in table 5.3.

Crop farming was also established as the main source of income among the interviewed categories of respondents. In Yatta and Mutomo Divisions for example, households derived 59% and 56% of their incomes from crop farming respectively, while in the project area participants and non-participants drew 56% and 55% of their incomes from the same. Majority of the remaining households derived their incomes from wage and regular employment as indicated in the table 5.3.

Table 5.3: Households' Main Source Of Income

	Non-Participants	Participants (Global)	Wii Catchment	Kiindu Catchment	Ithumula Catchment	Yatta Division	Mutomo Division
Crop farming	55	56	48	50	69	59	56
Regular employment	10	14	16	16	10	17	16
Wage earner	12	10	14	10	6	13	15
Business	10	13	10	18	10	10	11
Livestock	4	6	8	6	5	1	2
Other	9	1	4	0	0	0	0

In Kiindu catchment, 50% of the participants practised crop farming as their main economic activity while it was the secondary for 42% of them. Forty eight (48) per cent of the interviewed households in Wii catchment reported that they depended on crop farming as their main source of their livelihood and 48% as secondary. Data from Kyangunga sub-location indicate that 58% of those who constructed the dams depend on crop farming as their main source of income and 42% as the secondary source. Seventy (70) per cent (non-participants) depended on crop agriculture as their main source of income and 24% as the secondary source. Data from Kyangunga (Kiindu catchment) sub-location indicate that 58% of those who constructed the dams depend on crop farming as their main source of income and 42% as the secondary source. Seventy percent (non-participants) depend on crop agriculture as their main source of income and 24% as the secondary source.

In Ithumula/Maluma catchment, 69% and 27% of the participants had crop farming as their main and secondary sources of income respectively.

In the male-female disintegrated data, (see table 5.4) it was established that 53% and 42% in male and female-headed households respectively drew their main incomes from crop farming. Forty six (46%) per cent of the female headed households reported that they drew their incomes from wages and salaries, as remittances from their absent husbands. Thirty-two (32%) per cent of the male headed families similarly obtained their incomes from salaries and wages. Most of the salaries were earned from teaching, civil service, administrative jobs, and those employed in service industry within the District.

The variations in household head ratios in various divisions and sub-locations can be traced to a number of reasons; differences in resource endowment, which can influence the rate of migration. In areas where land is productive, chances of migration during famines are minimal while the rates of migration in areas, which are less endowed with resources, are bound to be high. The possibility of returning home after a famine incidence is high for people from areas with high resource endowment.

The implementation of sand dam technology involves both male and female labour. Availability of this labour affects the rate at which a dam is constructed. In cases where male labour is required for breaking of rocks for construction, enough male labour is necessary satisfactory project implementation rate.

Table 5.4: Main Income Source For Male-Female Headed Households (Participants)

Main Source	Males	Females
Crop Farming	53	42
Livestock	2	2
Business	10	5
Regular Employment	17	27
Wage Earning	15	19
Other	3	4

Table 5.5: Households' Annual Income In The Catchment Areas

Income	Non-Participants	Participants	Wii Catchment	Kiindu Catchment	Ithumula Catchment	Yatta Division	Mutomo Division
10,000 ≥ income	26	25	32	14	10	33	39
10,000 < income ≤ 30,000	33	36	32	54	67	27	30
30,000 < income ≤ 50,000	20	16	20	12	10	20	20
50,000 < income ≤ 100,000	18	14	12	16	5	18	10
100,000 < income	3	8	4	4	8	2	1
Total	100	100	100	100	100	100	100

From table 5.5, it can be seen that 56% and 61% of the non-participants and participants respectively were earning less than Ksh. 30,000 annually. Data from Kiindu catchment show that participation was highest (68%) among the poor, that is, those with annual incomes below Ksh. 30,000 per year. The respondents asserted that the level of interaction between the poor and the rich was limited. In Wii and Ithumula catchments, over 64% and 77% respectively of the participants had annual incomes of less than Ksh 30,000 per annum.

In Yatta and Mutomo, respondents had their annual incomes skewed towards low-income classes.

There was no significant difference in the levels of incomes across gender in the male-female analysed data as shown in the table 5.6.

Table 5.6: Households' Annual Income In The Catchment Areas

Income	Females	Males
10,000 ≥ income	14	13
10,000 < income ≤ 30,000	26	34
30,000 < income ≤ 50,000	19	17
50,000 < income ≤ 100,000	24	24
100,000 < income	15	13
Total	100	100

In Ithumula/Maluma sub-location, the results paint quite a different picture. The levels of income were found to be comparatively higher. Fifty (50) per cent of the respondents who participated in

building the dams were found to be earning between Ksh. 10,000 and 30,000 per annum. The lowest income earners (those with annual incomes equal or below Ksh. 10,000) comprise 27% of the participants. A very small percentage (5) was reported to be earning over Ksh. 50,000 annually.

From the foregoing discussion, it is evident that dry land farming is still the major occupation of households living in Arid and Semi Arid Lands. Other economic activities like live stocking keeping, business, regular employment and wage earning supplement crop farming income of the majority.

5.2.2 Animal Rearing

Birds:

In the study area, bird (chicken and ducks) keeping seems to be very important. Data from the baseline area show that 96% and 92% of the sampled households in Yatta and Mutomo division respectively, rear birds. In Yatta Division, 48% of the respondents keep more than six birds while in Mutomo 27% rear a similar number. Eight (8) per cent of the respondents in Wii Catchment reported that they did not keep chicken and ducks. In this catchment, 68% of the participants rear birds. In Kiindu and Maluma catchment only 10% and 5% of the participants respectively were found not to keep birds.

Goat/Sheep:

Equally important in the area is goat keeping as shown in table 5.7 above. Over 80% of the interviewed households in Yatta and Mutomo divisions rear either sheep or goats or both. The main reason behind these large percentages can be explained by the minimal care demanded by these animals as well as availability of rangeland unlike in the project area where population densities are very high.

Table 5.7: Animal Rearing

Number of birds/animals	Wii Catchment			Kiindu Catchment			Ithumula Catchment		
	Chicken	Cows	Goats	Chicken	Cows	Goats	Chicken	Cows	Goats
Nil	8	40	36	10	32	16	5	46	33
One (1)	24	0	0	4	38	42	10	0	0
1 < number ≤ 5	36	52	44	26	24	24	30	38	35
5 < number ≤ 10	24	4	16	26	0	0	28	12	25
10 < number	8	4	4	30	0	16	23	2	5
Not reported	0	0	0	4	6	2	2	0	0
Total	100	100	100	100	100	100	100	100	100

Majority of participants in the three catchments reported that they keep goats and sheep. For example, in Wii and Maluma catchments only 36% and 33% respectively do not keep goat/sheep.

In Wii catchment, 36% of the respondents do not keep goats and sheep while 64% keep more than one goat/sheep.

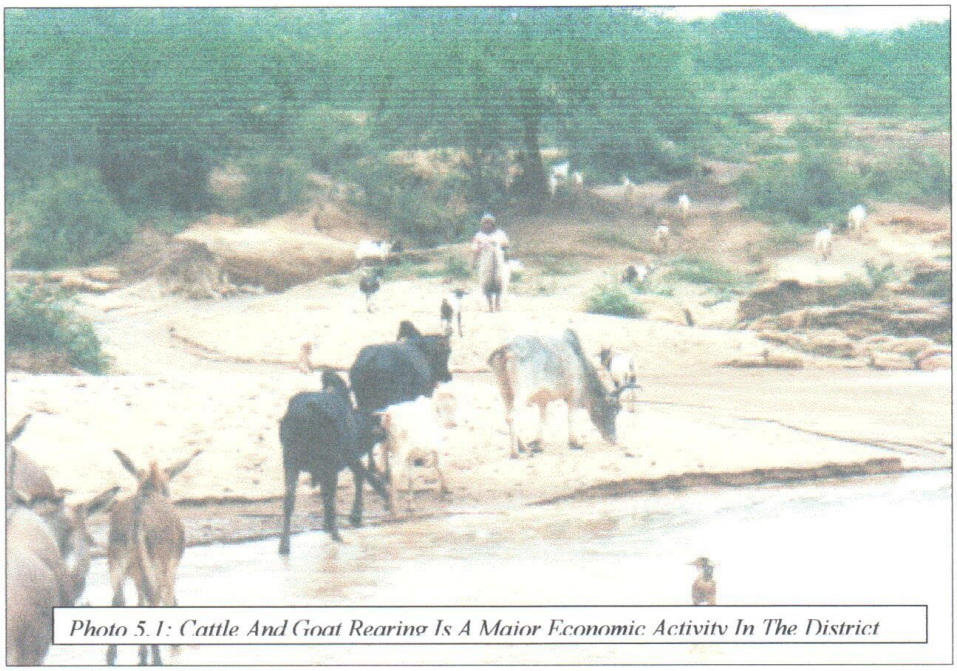


Photo 5.1: Cattle And Goat Rearing Is A Major Economic Activity In The District

Cattle:

A sizeable percentage (66) of the sampled households in the baseline area (Yatta and Mutomo Divisions) rear cattle with the majority having between one and five cows.

Majority of the participants in the catchment area (Wii, Kiindu and Ithumula) keep between one and five animals. Those with more than ten cows form less than 7% the respondents.

According to the District Development Plan (1997-2001), there were 948 households rearing cattle in Yatta division. The plan estimated the land carrying capacity as 5 Ha/lu. The main livestock products were reordered as meat, eggs, mutton, honey and wax. Those without cattle form less than 39% of the sample. This was quite high and is an indicator of the social status of the respondents. Cattle are reared for milk, for sale, or as draught animals. In most cases, respondents asserted that they keep cattle for security; they dispose off the cattle when there is no alternative source of income. This is common when there is drought (Republic of Kenya, 1997).

Donkeys:

In arid and semi-arid lands, donkey keeping is prominent. The donkey is a beast of burden, historically referred to as "the willing hard worker". It carries an average load of 90 kgs.

Over 70% those interviewed in the baseline area keep donkeys. This implies that the donkey is a very important animal in water scarce areas. Some respondents had more than one donkey. Where water source are at a closer proximity, ownership of donkeys is reduced. In the recent past, donkeys have become very powerful draught animal compared to bulls in water fetching and land tilling. This is probably driven by the fact that donkey can live off more degraded land than bulls.

In three catchments it was established that majority of the respondents do not keep donkeys. In Wii and Kiindu catchments, 60% and 52% of the participants respectively, do not own donkeys, while in Ithumula catchment only 15% own donkeys. This can be explained by a number of factors, the very steep terrain of Maluma for example makes it difficult to use the donkey as draught animal. Availability of pasture is another factor, which limits the rearing of donkeys in the central division.

5.3 CONTROL OF INCOME, LABOUR AND EXPENDITURE

An attempt was made to compare the control of household income, labour and expenditure between the catchments and the baseline area. Control of family resources has impact on project planning, implementation and distribution of benefits derived from projects. In situations where wives have to wait for decisions from their husbands residing outside the household leads to delays in project implementation. In cases whereby husbands living outside the household control incomes accruing from community projects, the wives loose morale of participating in such projects. It must be acknowledged that in most cases where husbands head households, there are wives in the household. Where households are headed by wives chances are that husbands are working outside the homestead, death, separation, divorce, single parenthood among other reasons.

Results from this analysis are presented in table 5.8. On average it was established that majority (over 40%) of the households' incomes were controlled by husbands. In Wii for example, 48% and 40% of husbands controlled family incomes and labour respectively even though 65% of the households were female headed. It seems that 13% and 5% of the husbands controlled incomes and labour respectively while residing outside their households. Expenditure was also controlled by males in most households (40%) in Wii. This does not seem to be a serious problem in Kiindu catchment with 48% females heading households. In Ithumula catchment, even though 57% of the households were female headed, only 18% of the females controlled labour, expenditure and income.

In Yatta Division, the percentage of women controlling income (15%), labour (24%) and expenditure (19%) was small compared to the percentage of women heading households (56%). In Mutomo Division, it can be observed that most households were male headed and decision-making was either done by the husbands or by husband and their wives.

In a nutshell, the issue of gender in decision-making seems not to be a serious problem in the entire study area. However, it would be more appropriate if decision-making and control of the household resources was in the hands of both the husband and the wife (jointly, where the husband is available) and wives (where the husband is not within the household). This means it could be ideal if row [F] could be in the range between 80% and 100%.

Table 5.8: Control Of Family Income, Labour And Expenditure

Person/s	Yatta			Mutomo			Wii			Kiindu			Ithumula		
	E	Y	L	E	Y	L	E	Y	L	E	Y	L	E	Y	L
Husband/Wife [A]	55	39	50	45	35	45	12	20	20	32	28	30	49	39	41
Husband [B]	22	41	22	37	50	37	44	48	40	26	38	26	33	43	41
Wife [C]	19	15	24	13	9	13	40	32	36	40	34	44	18	18	18
Other [D]	4	5	4	5	6	5	4	0	4	2	0	0	0	0	0
Husband/Wife or Husband alone [E]	77	80	72	82	85	82	56	68	60	58	66	56	82	82	82
Husband/Wife or Wife alone [F]	74	54	74	58	44	58	52	52	56	72	62	74	67	67	59
Household head [G]	Female: 56 Male: 44			Female: 44 Male: 56			Female: 65 Male: 35			Female: 48 Male: 52			Female: 57 Male: 43		

Key: E= Expenditure, Y= Income, L=Labour

5.4 HOUSEHOLDS' FARM IMPLEMENTS AND OTHER POSSESSIONS

In all categories of the respondents (participants and non-participants), 90% reported that they own farm implements. These implements range from jembes mattocks, spades to ox-ploughs. This has a direct bearing on project implementation because participants use their implements while working on the project. Some respondents reported that at times the inadequacy in digging implements in terms of quantity and quality acts as a limitation to their work. Tough implements are sometimes required for breaking hard rocks.

Table 5.9: Household Farm Implements

Number	Non-Participants	Participants	Ithumula	Kiindu	Wii	Yatta	Mutomo
Nil	0	1	3	0	0	6	5
1-5	63	60	57	34	90	50	52
6-10	30	36	40	58	10	42	40
More than 10	7	3	0	8	0	2	3
Total	100	100	100	100	100	100	100

The table 5.10 shows other household possessions in some selected survey areas. The table show the percentage of ownership of various households' possessions. These are indicators of social economic status of the households. Carts and wheelbarrows are used in transportation of the required materials such as sand, water and stones. Televisions and transistor radios have bearing on access to information. As it can be deduced from the table below, ownership of carts/wheelbarrows lower than that of the bicycles on average. Ownership of radios and televisions is higher among the respondents in Kiindu catchment.

Table 5.10: Other Household Possessions

Possession	Non-participants	Participants	Wii	Kiindu	Ithumula	Yatta	Mutomo
Carts/Wheelbarrows	24	30	32	40	18	21	19
Bicycles	42	38	28	58	28	47	51
Plant Machines	10	8	4	5	15	2	6
Motor Vehicles	4	7	8	0	3	1	2
Televisions/Radios	7	15	16	26	5	4	2

5.5 QUALITY OF HOUSING

Information pertaining quality of housing in the study area is found in the tables 5.1.1, 5.1.2, 5.1.3. The construction material, which is mainly used by over 50% of the respondents in Yatta and Mutomo Division, is brick and mud. The quality of housing is relevant to the health of the people over and above it being an indicator of poverty.

Main House Wall Material

Majority of participants (54%) and non-participants (50%) use brick and mud as the main wall construction material. For example in Kiindu and Wii catchment, 59% and 44% of the participants respectively use brick and mud as the main construction material respectively. Use of brick and mud was highest in Mutomo (67%) and Yatta (69%). Brick and cement occupied the second position with highest percentages reported in Wii (52%) particularly among non-participants (46%).

Table 5.11: Wall Material

Wall Material	Non-Participants	Participants	Ithumula	Kiindu	Wii	Yatta	Mutomo
Brick and Mud	50	54	59	59	44	69	67
Brick and cement	46	41	36	36	52	19	27
Block and cement	1	1	0	0	4	1	2
Poll and Mud	3	3	5	5	0	5	2
Other	0	0	0	0	0	6	2
Total	100	100	100	100	100	100	100

Quality of Main House Floor and Thatch

Over 60% of the entire sample population had their houses un-cemented and thatched with iron sheets as shown in table 5.12 and 5.13. Wii catchment reported the highest (96%) use of iron sheets and least cemented (10%) house floors.

Table 5.12: Floor Quality

Wall Material	Non-Participants	Participants	Ithumula	Kiindu	Wii	Yatta	Mutomo
Cemented	38	40	23	42	10	15	11
Uncemented	62	60	77	58	90	85	89
Other	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100

These findings show that on average over 50% of the community members could not afford decent building materials. This is supported by the high percentages of those using brick and mud as the wall materials for their main house. Most residents are able to make bricks particularly after construction of the sand dams, while majority cannot afford cement and iron sheets. This accounts for the high percentages of those using bricks and mud in construction of their houses among the participants. The very high percentages of those living in un-cemented houses (an indicator of poor housing condition) are also indicative of the poverty of the district people. The cost of cement seems not to be economically feasible for over 60% of all the respondents in the study area. A shift from grass to iron sheets as the major roofing materials has been noted.

Table 5.13: Quality of Thatch

Thatch	Non-Participants	Participants	Ithumula	Kiindu	Wii	Yatta	Mutomo
Iron Sheets	77	85	64	84	96	54	61
Grass	23	15	36	16	4	46	38
Tiles	1	0	0	0	0	0	1
Total	100	100	100	100	100	100	100

5.6 DOMESTIC SOURCES OF ENERGY

Global data from the participants and non-participants show that 97% and 98% of the households respectively use wood as the main source of energy. Details from specific catchments can be obtained in table 5.14. As indicated in the table, over 95% of the participants both in the baseline and the built-up areas use firewood as their major source of energy for domestic use. Kerosene use was recorded the second most used source. Use of charcoal fuel was limited to a smaller percentage of the households.

The table 5.14 shows that wood is the single most important source of energy for households in Kitui district. The rate at which trees are being cleared to create farming land and for charcoal burning portends a major challenge to development partners in the whole district. The training offered by SASOL during construction of dams, stresses on the importance of tree planting as a method of soil conservation, source of energy and timber for construction. There is need for SASOL to continue putting a lot of weight on tree planting and conservation in the new project areas (Yatta and Mutomo Divisions).

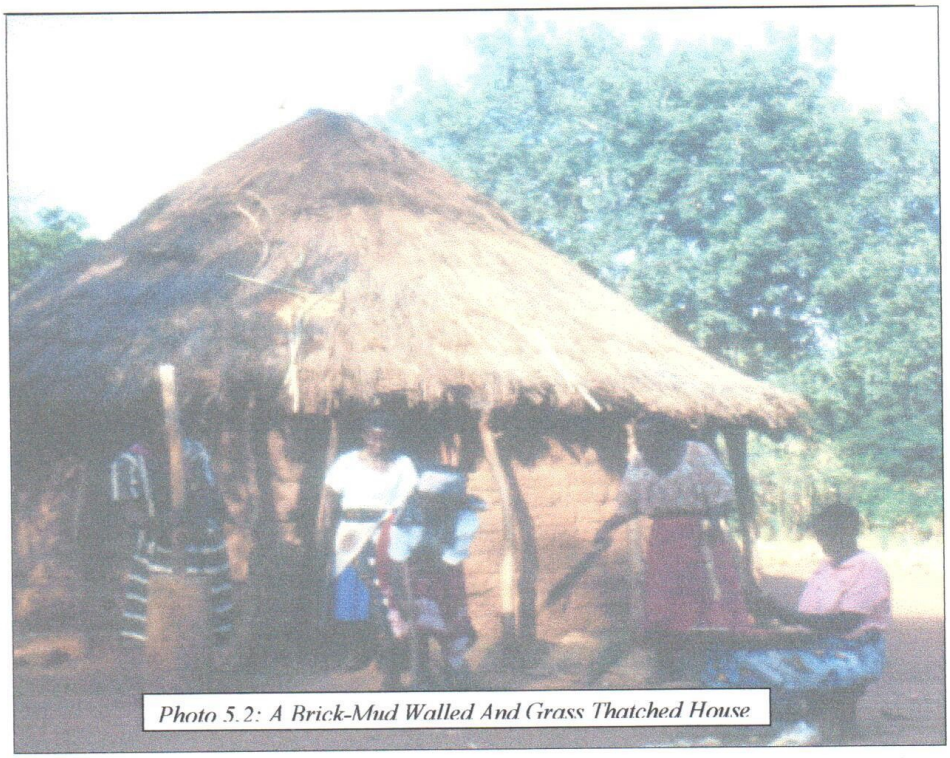


Photo 5.2: A Brick-Mud Walled And Grass Thatched House

Table 5.14: Energy Sources

	Yatta		Mutomo		Wii		Kiindu		Ithumula	
	First	Second	First	Second	First	Second	First	Second	First	Second
Firewood	98	0	99	0	92	4.0	100	0	97	3
Charcoal	2	19	1	6	4	16.0	0	22	0	13
Kerosene	0	67	0	87	4	64.0	0	74	3	82

5.7 MIGRATION

During famines are men migrate to other areas in search of employment. Likewise people migrate from the densely populated areas to the less densely populated areas in search of farmland.

Respondents were asked to tell whether any family member had migrated, the reasons for migration and the place of settlement. The results indicate over 22% of the respondents in both the baseline and the catchment area (except for Wii and for non-participants) had one of their family members migrate. Wii catchment registered the lowest (16%) number of individuals migrating. Majority of the respondents reported that search for employment was the major reason behind these migrations. For example, in Yatta and Mutomo 17% and 11% respectively was

reported to have shifted to towns in search of employment opportunities. Land inadequacy was also cited as another cause for migration.

Table 5.15: Nature Of Migration

Nature	Non-Participants	Participants	Wii	Kiindu	Ithumula	Yatta	Mutomo
Temporary	7	2	2	2	5	12	6
Permanent	10	7	4	12	10	5	14
Working outside	9	9	8	14	13	7	6
Total	16	18	16	28	28	24	26

Most people who migrate do so in search of employment. Permanent migration has been witnessed due to land inadequacy and sometimes in search of fertile lands. Temporary migration in some cases is a drought coping mechanism in Kitui.

6.0 WATER SOURCES

6.1 WATER IS NECESSARY FOR LIFE

Water is the life-blood of any community or society (Koech, 1981). Water is the most essential commodity in the entire Kitui district. Its development occupies the number one position in priority ranking of projects in Kitui[9]. The necessity of water availability for survival of both man and animals is common knowledge. In fact, access to safe water has been considered a very key basic need (Koech ibid).

It is assumed that rural development projects are aimed at improving the quality of life of the rural households. Thus any meaningful development project has to focus on the essentials of improving the quality of life. Water is rapidly becoming a scarce resource in almost all countries driven by growing populations on one hand, and changing weather patterns. This scarcity makes water both a social and an economic good (GOK, 2002).

The research intended to establish whether rural households in Kitui have the same point of view described above in relation to water. Respondents were asked to state those goods and services without which life would be extremely precarious. From the results, it was deduced that food ranked the highest (average 91%) closely followed by water (average 82%). Clothing (26%) and shelter (23%) occupied positions three and four respectively. Others were money, land and fuel in the fifth position and education and medical care in the sixth, while clean environment occupied the seventh position. Livestock and transport trailed.

This results show that the sand dams project was focused on a community priority need and thus is justified. The findings are summarised in the table 6.1 and 6.2. There was a consuses between women and men over the importance of water.

Table 6.1 shows that all respondents ranked water and food as the most important necessity in life. Respondents from Yatta division gave water a low score compared to Mutomo division because Athi river passes through Yatta thus those near the river are have access to water through out the year. There is a potentially serious problem, with the increasing rate of pollution of Athi River, driven by urban pollutants of Nairobi, Athi River, Machakos and other small centres as well as coffee and cotton growing farms, this source is becoming increasingly dangerous to public health. Respondents living along the River asserted that the water is affecting them and their livestock. They said that boiling the water does not make it any better. Respondents said that they suffer from stomachache. Those who water their animals in the river asserted that their animals have stunted growth. Those with alternative sources of water are no longer sourcing domestic water from the river and are also attempting to keep off their animals from the river.

6.2 MAIN WATER SOURCES IN PROJECT AREAS

At the catchment level, sand dams dominated the main household water source as shown in table 6.3. During the wet season, households have a variety of water sources as indicated by the results. This choice was limited to a few sources during the dry season.

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[9] See Republic of Kenya (1997): Kitui District Development Plan 1997-2001

Table 6.1: View Towards Necessities of Life (Participants And Non-Participants)

Item	Non-Participants	Participants	Kiindu	Ithumula	Wii	Yatta	Mutomo	Rank
Food	95	96	100	97	92	68	93	1
Water	75	80	96	85	76	79	88	2
Clothing	43	22	34	21	12	24	32	3
Shelter	15	25	32	26	16	29	23	4
Money	14	27	32	31	20	1	13	5
Land	4	28	50	23	12	8	12	5
Fuel	21	27	48	33	0	3	5	5
Education	28	16	44	0	4	1	21	6
Medical care	26	10	0	18	12	19	25	6
Clean environment	2	9	10	8	8	0	1	7
Transport	0	0	0	0	0	24	8	8
Livestock	0	0	0	0	0	19	12	8

Table 6.2: View Towards Necessities of Life (Female-Male Analysis)

Item	Females	Males
Food	83	86
Water	64	69
Clothing	22	31
Shelter	18	21
Money	12	15
Land	9	9
Fuel	18	19
Medical care	18	17
Clean environment	2	5

During the dry season, 74% of the participants (from the global data) throughout the project area reported that they use sand dams as their main source of water while 17% use wells. During the wet season, 32% of the households retain sand dams as their main source of water as other household turn to wells (21%), roof catchment (18%), scoop holes outside dams (17%) and ephemeral springs (6%).

Among the non-participants global data, it was found that 70% and 19% use of scoop holes and wells respectively during the dry season. During the wet season, 36% and 20% source water from scoop holes and wells respectively. Nineteen (19) and eleven (11) per cent of the non-participants use roof catchment and rivers as the main source of water.

Specific data from Kiindu catchment indicate that 92% of the households obtain water from scoop holes during the dry season with some relying on wells and storage tanks before the construction of the sand dams. In the wet season, some households used wells (34%), roof catchment (16%), while 40% of the households continue sourcing water from scoop holes in the rivers. After the project, particularly during the dry season, it was reported that 68% of the households turned to sand dams with others still continuing to draw water from wells and scoop

holes. In the wet season, water source was limited to the same sources with variation in intensity of use with 6% relocating to roof catchment. It should be noted that due to construction of sand dams, some rivers backed-up for considerable distances (some a couple of kilometres) thus making it possible for some households to scoop water in the points nearer their homes than before the project.

Among the participants in Kyangunga sub-location (Kiindu catchment), scoop holes (86%) dominated their water choice during the dry season before the project. Few cases of households making use of piped water and springs were also recorded. In the wet season, the water source choice widens. Households used to draw water from wells, dams, roof-catchments, scoop holes, springs and piped water, and with rivers being the majority choice. After the project, there occurred variation in water source choice. Sand dams (47%) and scoop hole (33%) being the favourite sources in the dry season. During the wet season, the number of households drawing water from the sand dams remains, but, given the perceived water quality change in the other sources, diversification to sources like ponds and temporary wells occurs. Thus water for different uses is sourced from different sources.

In Kyambiti (Kiindu catchment) 80% of the households relied on scoop holes before the project. Notable changes were reported after the project with reliance on wells going up from 9% to 18% after the project and sand dams (42%) coming into use. Use of scoop holes declined to 42% after the initiation of the project. Before the project, 70% of the households fetched water from scoop holes while after the project there is a significant shift towards use of sand dams (75%).

In Mbitini (Kisiio catchment) water sources were mainly earth dams and scoop holes before the implementation of the project. After the project, majority (78%) of the respondents turned to sand dams. They reported that they had no alternative water sources.

In Ithumula catchment, similar results were reported. Participants relied more on scoop-holes (70%) and wells (21%) during the dry season before the project. In the wet season, their water source choice could widen to include rivers, springs, roof-catchments and rock-catchments among others. After the project, 58% of the respondents started using sand dams during the dry season. The number using scoop-holes declined to 12%.

Majority of the households, 80% in Wii catchment used to draw water from scoop holes in dry season before the project, while in the wet season (44%) relied more on rivers, wells and springs. After the project, during the dry season, water source pattern suddenly changes with 60% of the households turning to sand dams while 32% still continue drawing water from scoop holes. The number sourcing water from wells reduces from 20% to 4%. In the wet season, use intensity of the sand dams slightly reduces to 56%. Other sources in the wet season include roof catchment (12%), wells (16%) and rivers (16%).

Among the non-participants, households rely more on scoop holes in the dry season. It was registered that 88% and 80% use scoop holes in Kiindu and Wii catchments respectively, in the dry season. The other source, though not significant, is wells. During the wet season, the number drawing water from scoop holes diminishes with other sources like roof catchments and rivers coming in.

Table 6.3: Water Sources

Main Sources Of Water	Yatta		Mutomo		Kiindu		Ithumula		Wii	
	D	*W*	*D*	*W*	*D*	*W*	*D*	*W*	*D*	*W*
River	68	53	13	6	0	4	8	8	0	16
Scoop holes	12	4	46	17	4	4	3	0	32	0
Wells	12	6	10	6	14	16	31	33	4	16
Boreholes	3	2	4	0	0	0	0	3	0	0
Earth dam	3	10	12	21	0	0	0	0	0	0
Springs	3	4	2	5	0	0	0	7	0	0
Roof catchment	0	20	0	10	2	14	0	3	0	12
Rock Catchment	0	0	12	31	0	0	0	3	0	0
Sand dams	0	0	2	2	68	62	56	28	60	56
Piped	0	0	0	0	0	0	3	4	4	0

Key: - D: Dry season; W: Wet season

Scoop holes in Syomunyu sub-location, (Kanyangi) are the most dominant (87%) sources of water.

In Kathungu sub-location (Ikanga) the main water sources are scoop holes (49%), piped water (21%) and earth dams (20%).

In Kiangwa (Ikanga) the main source of water is an earth dam (69%). Wells (31%), piped water (24%), springs (22%) and rock catchments (16%) were reported as the main sources of water in Ndakani location (Mutha Division).

From the foregoing discussion, it is clear that most households in the project area are now relying on sand dams as their main source of water during the dry season. During the wet season, there are other alternative sources of water although most of them are open to contamination.

Box 6: KITUI DISTRICT WATER POINTS DEVELOPED IN THE EIGHTIES

1. Mutomo Soil and Water Conservation Project.
This project constructed 546 water points between 1982 and 1989 in Mutomo Division.

2. The USAID ASAL Project
This project constructed 269 water points between 1981 and 1987. It covered all areas of Kitui district outside Mutomo division, which was covered by the Mutomo project.

3. UNICEF School Water Tank and VIP Latrine Programme.
Yatta, Katse and Nuu locations had each 40 completed tanks. In Katse 5 tanks were repaired. 8 were repaired in Nuu. Katse has 40 VIP toilets completed and none in Yatta

4. KIDP Water Activities 1989-1990
KIDP very quickly developed a water implementation programme. Within the first year the following had been accomplished.

a. Water Pans:

There were 40 built by the MS&WCP. 15 were built in 1990.

b. Water Tanks:
The previous Mutomo project constructed 338 water tanks. 72 water tanks were constructed in 1990 in Mutomo. 10 were rehabilitated. 2 water tanks were constructed for Pentecostal Church of Canada in 1990 in Kyuso.

c. Rock Catchments;
During 1990, 4 new rock catchments were completed and 6 were repaired in Mutomo.

d. Sand Dams:
One sand dam was constructed in Mutomo

In summary then there were a total of 1018 water points built between 1980 and 1990. It is estimated that at least another 2,000 water points existed on the ground. These are from community initiatives mainly and some NGOs from the earlier period. Thus a total of not less than 3,000 water points existed on the ground at the end of 1990

6.3 CHOOSING SOURCES OF WATER

Like other ASAL communities, in Kitui, communities are endowed differently with water resources. Some communities have alternative water sources while others depend on only one source. It should be noted that different water sources offer different qualities, quantities and have different levels of reliability. What factors then, do households consider in choosing a water source? This question guides development partners who undertake to design a project to addresses the local water needs. Respondents were asked to rank the factors, which they consider while choosing a water source. The results of the rankings are found in the table 6.4.

From the male-female analysis, distance was priority number one to both sexes. Quantity was ranked second by females. Quality was ranked second by males. Men mind the quality to quantity because majority of them are not involved in water fetching. They are less aware of the pains undergone by women while looking for sources of quality water.

The results indicate that distance to water source was the most important factor in determination of a water source, followed by quality and quantity in the second rank. Reliability and quantity were ranked third. Other mentioned factors included opportunity for multiple use and lack of other alternatives. The above observations are in line with SASOL's objectives even though quality of water was not among the set project goals. The project design clearly stated that quality of water would be dealt with once water was provided to households at a distance of less than two kilometres.

Table 6.4: Factors Considered When Making Choice Of A Water Source

Sub-Location/Catchment	Rank 1	Rank 2	Rank 3
Ithumula catchment	Distance	Quality	Quantity
Kiindu catchment	Distance	No alternative	Quality
Kisiio catchment	Distance	Quantity	Reliability
Wii Catchment	Distance	Quantity	Quality
Mwiiwe catchment	Distance	Quantity	Reliability
Nzangathi s/location	Distance	Reliability	No alternative
Kyangunga s/location	Distance	Quantity	Quality
Wii s/location	Distance	Quantity	Multiple use
Kyanika s/location	Distance	Quality	No alternative
Ithumula/Maluma s/location	Distance	Quality	Quantity
Ngangani s/location	Distance	Quality	Quantity
Masimbini s/location	Distance	Quality	Reliability
Kitungati s/location	Quality	Distance	Quantity
Ngiluni s/location	Distance	Quantity	Reliability
Yatta Division	Distance	Quantity	Quality
Mutomo Division	Distance	No alternative	Quantity
Female	Distance	Quantity	No alternative
Male	Distance	Quality	Quantity
Summary (High frequencies)	Distance	Quantity	Reliability

6.4 FETCHING AND TRANSPORTING WATER

Data for both participants and non-participants indicate that the burden of water fetching still rests in the female domain, that is women and girls both before and after the project, as reported by half of the respondents.

In Ithumula catchment, it was reported that before the project, most of those responsible for fetching water were females (43%) and after the initiation of the project, the figure decreased by 3%. Among the participants, in the same area, before the project, 69% of those responsible for fetching water were females, after the project, there was no significant change. Non-participants data shows that over 80% of those who fetch water are females.

In Kiindu catchment, more than 70% of those responsible for fetching water were women before the initiation of the project. There were no men fetching water before the project, after the project, there is a significant shift. Two (2) per cent of men are undertaking the activity and the burden of fetching water is spread among different groups. The shortened distances to water sources can explain the increased involvement of men in fetching of water. Men find it easy and quick to fetch water for some of their activities instead of waiting for women to do it especially if the men are in hurry and the women are busy or are away. Likewise, men who have started some economic activities, after the initiation of the project, opt to fetch the water themselves. This can also be supported by the percentage increase in the number of boys involved in fetching water. The percentage increases from 2% to 4%. In Wii catchment, data show that, 70% of those who fetch water are the females.

Table 6.5: Water Fetching Responsibility

Party	Global Participants		Before the Project		After the Project	
	Before the project	After the Project	Males	Females	Males	Females
Husband/Boys	4	6	3	4	5	5
Wife/Girls	50	49	47	59	46	51
Wife/Boys	13	12	17	9	17	11
Other	33	33	33	28	32	33

In the female-male segregated data, the responsibility of water fetching is bestowed upon females (women and girls). However, it can be deduced that after the project more boys were now fetching water. When distances to water source shorten, the boys are engaged in water fetching.

For the participants, before the project, the responsibility of fetching water was well spread among all family members although the burden is still vested on females. After the project, the activity is still well spread among different members although the burden is tilted towards females. Fewer men were involved in fetching water. Some of the reasons advanced for less involvement in the activity are: that given easy availability of water, men can bath in the rivers instead of fetching water or they clean their clothes in the rivers instead of carrying the water home. On the other hand, because of the raised water tables, during the dry season, men are no longer involved in guarding women during the night while queuing for water or digging the deep scoop holes. In the baseline area the distribution of the responsibility is as shown in the table 6.6. The greatest burden still falls within females.

Respondents were asked to identify the means they use transporting water. People are influenced by several factors in choosing means of transport. Some of the factors which determine what to use in transport include: the availability of means, the cost of transporting the goods, the volume of the goods, distance to destination, carriage etc.

Global participants data indicates that water transport is mainly done through use of human labour (60%), the donkey (26%), the ox-cart and the wheelbarrow (6%) after the project. Human labour (56%) and donkey (27%) were the most commonly used means of transporting water before the project.

In Kiindu and Ithumula catchments, human labour remains the most important means of transporting water as shown in the table 6.7. No significant shifts were recorded in means of transporting water before and after the project. In Wii sub-location, there were slight changes, from use of donkeys before the project to use of wheelbarrows and carts after the project.

Table 6.6: Responsibility of Water Fetching (Catchment And Baseline Areas)

	Yatta	Mutomo	Kiindu	Ithumula	Wii
Wife	24	39	40	36	40
Wife and Boys	11	11	9	23	10
Wife and Girls	30	14	30	33	30
Boys and Girls	13	14	7	5	14
Boys	11	11	7	3	4
Girls	11	10	7	3	4

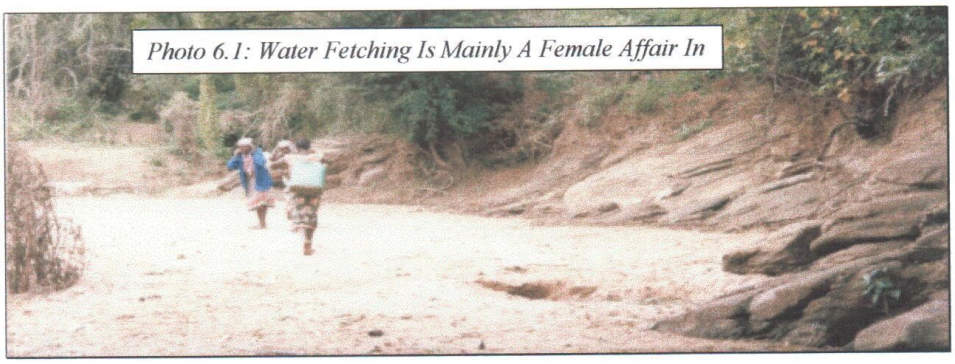


Photo 6.1: Water Fetching Is Mainly A Female Affair In

6.5 MEANS OF TRANSPORTING WATER IN KITUI

In Wii, the donkey remains the major means of transporting water from the source to their homes, as reported by 48% of the participants. This is explained by the dry nature of Wii catchment, which is suitable to donkey rearing. Thirty-six (36%) of households in this catchment also use human labour. Eight (8) per cent of the participants asserted that they use a combination of both human labour and donkeys.

Majority (84%) of the participants of Ithumula catchment use human labour as means of transporting water, this is in sharp contrast compared to the rest of the district. Only 8% reported use of the donkey as a means of transporting water and 8% reported a combination of the two. This is explained by Ithumula's hilly terrain and large population density. There simply is no land for grazing donkeys.

Almost all the households in Mutomo and Yatta Divisions, baseline area, had donkeys as shown in the table 6.7. This is due to long distances household have to trek in search of water and plenty of pasture. The keeping of donkeys in the Central division is restricted by limitation of the land resource hence limited pasture. This is clear Ithumula catchment; the high population density limits pasture lands because most of the available land is put into crop cultivation.

Table 6.7: Means of Transporting Water After the Project

Means	Participants-Global	Kiindu	Wii	Ithumula	Yatta	Mutomo
Donkey	26	22	48	8	85	67
Human and Donkeys	11	16	8	8	5	22
Human labour	60	60	36	84	7	5

In Kyangunga catchment for example, 59% of the interviewed non-participants reported that they use human labour in fetching water while 29% use donkeys and 6% carts/wheel barrow. The participants used diverse means of fetching water before the sand dams were constructed. 42% of them reported that they used human labour, 42% used donkeys, 2.3% cart/wheel barrow 2.3% motor vehicles, and 9.0% used a combination of human labour and donkeys while 2.3% used a

cart, wheelbarrow or human labour. The project seems to have changed the means of fetching in Kyangunga. The percentage of those using human labour increased from 42% to 51%. This change is due to the shortened distances to the water sources. It is less tiring and more efficient to fetch water using human labour compared to the situation before. The percentage of those using donkeys dropped from 42% to 35%. The other means remain unaltered.

The results are in line with findings of Mutie (1993) who reported that in Kitui, possession of a cart or donkeys among many of the study population looked more of a basic requirement other than an indicator of any particular status or wealth.

7.0 DIRECT WATER SUPPLY IMPACTS

7.1 DAILY WATER USE

It was established that there was a marked increase in water consumption after the initiation of the project. In Kiindu catchment, for example, participants' data show that the category of respondents consuming (cooking) 20 litres per day reduced from 38% to 4%. This was accompanied by a corresponding increase in the percentage of respondents using between 40 and 60 litres in cooking from 4% to 22%. Before the project, none of the respondents reported having used more than 80 litres of water per day in cooking. After the project, 8% of the respondents were reported to be using more than 80 litres of water per day in cooking.

Similar increases in water consumption were reported in Wii and Ithumula catchment among the participants and non-participants living in the project area.

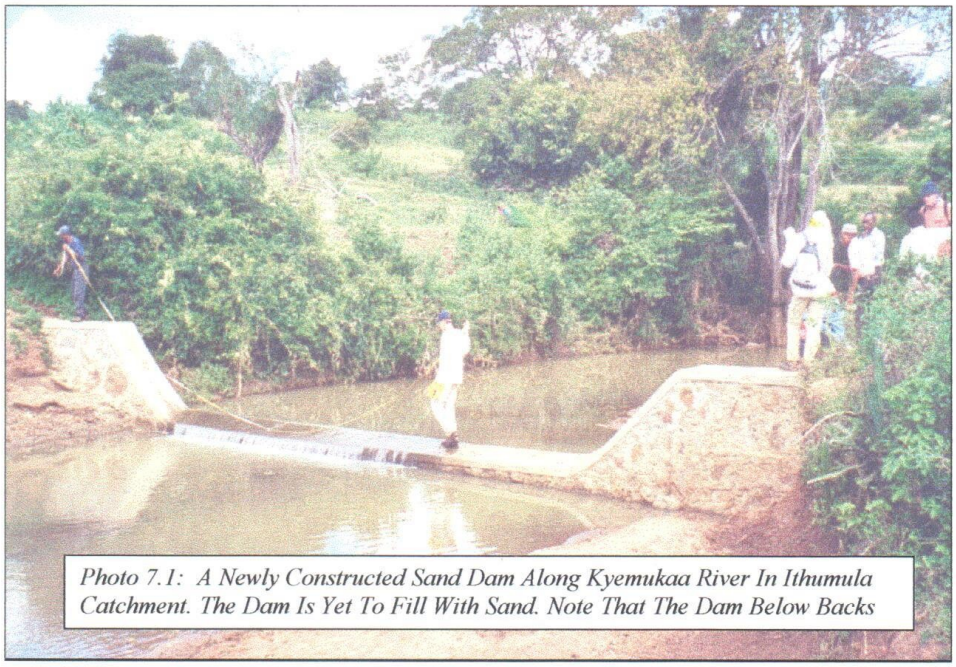


Photo 7.1: A Newly Constructed Sand Dam Along Kyemukaa River In Ithumula Catchment. The Dam Is Yet To Fill With Sand. Note That The Dam Below Backs

7.2 QUANTITY OF WATER CONSUMED

Among the objectives of the project, provision of water for both domestic and production purposes was central. Data on daily water use was collected and analysed.

From the global data, it was found that over half of the participants had their daily water consumption rise to over 100 litres per day during the wet and dry seasons after the project. Majority of them used less than 100 litres of water with 80-100 litres being the modal class.

In Ithumula catchment, water use increased after the project. Frequencies in 40-60, 60-80 and 80-100 litres increased during the dry season. There was no marked difference before and after the project in water use during the wet season.

In the female-male segregated data, similar trends were observed. Quantities of water fetched increased after the project, however, there were no marked variation across gender.

Table 7.1: Quantity of Water Used

Litres	Yatta		Mutomo		Ithumula		Wii		Kiindu	
	D	*W*	*D*	*W*	*D*	*W*	*D*	*W*	*D*	*W*
40 and below	18	16	22	17	15	5	4	40	4	2
Over 40-60	13	15	13	16	26	26	4	20	8	4
Over 60-80	29	31	37	31	15	23	28	16	20	4
Over 80-100	13	13	5	6	21	23	32	44	18	32
Over 100	27	25	22	30	23	23	32	16	50	58

Key: D= Dry season, W= Wet season

Wii catchment was not markedly different, over 60% of participants were found to use over 80 litres of water per day in the dry season while 60% consume over 60 litres per day in the wet season. Similarly, in Kiindu catchment 50% and 58% of the participants utilise over 100 litres of water during the dry and wet seasons respectively.

In Kyangunga sub-location (Kiindu catchment), the project brought about insignificant change in water consumption. The highest frequencies (over 50%) were almost equally distributed between over 60 and below 100 litres water consumption brackets.

The quantity of water carried home increased slightly in Mbitini sub-location (Mbitini) with frequency distribution being skewed toward higher quantity classes. This slight increment is accounted for by the fact that due to shorter distances to water sources cattle watering (especially the calves), clothe washing and bathing could be done at the source.

The modal class was 60-80 litres with 28% of the respondents in Syomunyu (Kanyangi) while the same was 80-100 litres for 32% of the respondents in Kathungu sub-location. In Ndakani 56% of the respondents are restricted to below 40 litres in a day.

An attempt was made to use simple *Ordinary Least Square* (OLS) method to model the determinants of water quantity fetched in Ithumula and Kiindu catchments, both before and after the project. Quantity of water fetched was regressed on a vector of some exogenous variable (perceived determinants). These variables included quality of water, distance to water source, time taken to and from the water source, household size, household composition, annual income, sex of the head of the household, means of fetching water, party responsible for fetching water, number of trips to the water source and depth of scoop holes.

It was feared that the distance to the water source is highly correlated (related) to time taken, however, it was established that this relationship is very weak and thus allays fears of running into multicollinerarity problem. This is because time taken to and from the water source includes

waiting, fetching and probably loading time that is not collinear[10] to the distance travelled. The statistically insignificant explanatory variables were removed step-wise from the model. These are the variables, which contributed least to the explanatory power of the model (superfluous variables). This process was repeated in stages until a plausible model was arrived at. The results are presented in table 7.2

Table 7.2: Determinants of Water Quantity

	Ithumula Catchment		Kiindu Catchment	
	Before IWSS	After IWSS	Before IWSS	After IWSS
Distance to water source	-0.814*	-0.002	-0.184	-0.288
	(-1.557)**	(-0.018)	(-1.257)	(-1.943)
	[0.200]***	[0.986]	[0.214]	[0.059]
Trips	0.199	0.340	0.318	0.054
	(1.309)	(2.55)	(2.278)	(0.412)
	[0.200]	[0.016]	[0.027]	[0.682]
Person fetching water	0.018	0.058	0.296	0.204
	(0.112)	(0.392)	(2.808)	(1.527)
	[0.912]	[0.698]	[0.007]	[0.133]
Means of fetching water	0.259	0.368	0.372	0.133
	(1.583)	(2.397)	(3.338)	(1.063)
	[0.123]	[0.023]	[0.002]	[0.292]
Depth of scoop holes	-0.104	-0.34	-0.091	-0.195
	(-0.700)	(-2.586)	(-0.723)	(-1.855)
	[0.489]	[0.014]	[0.473]	[0.069]
Time to and from	-0.62	-0.359	0.046	-0.1411
	(-2.83)	(-2.716)	(-2.282)	(-2.812)
	[0.008]	[0.011]	[0.019]	[0.007]
R^2 =	$R^2 = 0.345$	$R^2 = 0.487$	$R^2 = 0.434$	$R^2 = 0.1.87$
$F_{(\text{degrees of freedom})}$ =	$F_{(5,32)} = 2.815$	$F_{(6,32)} = 5.071$	$F_{(6,55)} = 7.034$	$F_{(6,55)} = 2.114$
[Probability]	[0.26]	[0.001]	[0.000]	[0.066]

Key: *= Standardized coefficient, **= t-ratio, ***= Probability

From table 7.2, distance to the water source is negatively related to water quantities though not very significant in the catchments under study. This is so even though distances were reduced for some households, others were trekking the same distance. It is only time taken in water fetching activities that reduced due to reduced depth of scoop holes and increased quantities of water at the source.

Time taken to and from the water source was found to be significant and negatively related to quantities of water the households fetched daily. Depth of scoop holes became significant after the project in the two catchments. Number of trips to the water source, the individuals and means

[10] No one-to-one relationship between the two variables

of fetching water were positively related to quantities of water fetched though not very significant in some catchments.

The sand dam project saw households living in the project area use more water in a day than their counterparts in the water scarce baseline areas of Mutomo and Yatta. Time taken to and from water source and depth of scoop holes in the catchment areas are major determinants of water quantity.

7.3 DISTANCE AND TIME TAKEN TO WATER SOURCES

Distance To Water Source And Trips

Generally, walking 5 to 10 kilometres to a water source is not uncommon for most families in Kitui district (Akong'a, 1985). In places like Voo, Endau and Mutomo women walk as long as 25 kilometres in the dry season (Kitui District Development plan, 1989). This kind of distance is almost unmanageable and one may wonder whether one does anything else after covering such a stretch daily (Mutie, 1993).

Table 7.3: Distance To Main Water Source (Km)

	Kyangunga sub-location				Ithumula sub-location				Kiindu catchment				Ithumula catchment			
	Before IWSS		After IWSS		Before IWSS		After IWSS		Before IWSS		After IWSS		Before IWSS		After IWSS	
Distance (KM)	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W
Below 0.5	26	40	44	51	39	71	47	68	10	22	50	42	44	69	69	80
Over 0.5 and below 2	58	44	51	42	34	21	49	22	34	46	46	42	41	26	31	21
Over 2 and below 5	14	9	0	2	18	3	4	1	34	16	4	4	10	0	0	0
Over 5 and below 10	0	0	0	0	7	1	1	1	20	2	0	0	5	0	0	0
Over 10 and below 15	2	5	2	2	1	0	0	0	2	0	0	0	0	0	0	0
Over 15	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0
not reported	0	2	2	2	0	4	0	8	0	14	0	12	0	5	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Key: D= Dry season; W= Wet season

Water problem in Kitui relates to the long distances women and children have to travel for water, which leaves them with little time and energy for other economic and social activities. In most cases, this adversely affects their performance on farm and in school respectively. A long distance to water sources makes water a scarce resource. Rationing of water sometimes results from the long distances to the sources. This compromises personal and household hygiene and makes household members vulnerable to diseases.

From the global participants data, it was established that 74% used to trek more than 1/2 of a kilometre before the project in dry season. After the project, on average 45% of the participants could walk less than 1/2 kilometre in search of water.

Data shows that, before the implementation of the project, 56% of participants from Kiindu catchment used to trek for over 2 kilometres in search of water in the dry season. The distances reduced significantly during the wet season with 68% of the respondents trekking for distances below 2 kilometres. After the project, it was reported that distances shortened with 50% of the committee members reporting that they now access water from sources, which are less than half a kilometre from their homes, and 96% trekking less than 2 kilometres for water in the dry season. In the wet season, 84% walk less than 2 kilometres while 12% walk negligible distances as they use roof-catchments.

Distances to the main water sources reduced in Ithumula catchment during the dry season. It was found that over 80% of the participants now trek for less than 2 kilometres in search of water after the project.

Participants in Wii sourcing water from a distance less than half a kilometre from their homes increased from (16%) before the project to 32% after the project. This means that the project reduced distances to water sources for 50% of those trekking for more than half a kilometre to source water from sources within or less than half a kilometre from their homes.

Almost similar trends were encountered in female-male divided data, but with more females (45%) reporting that after the project distances reduced to half a kilometre compared to 38% males. Men were found to overestimate distance to water sources before and after the project.

In Kyambiti (Mulango) distances to water source reduced to less than half a kilometre for 51% of the interviewed households.

Seventy (70) per cent of the households in Ngangani (Kisasi) are able to access water within a distance of less than 2 kilometres after the project.

Distances drastically reduced for most of the residents of Mbitini sub-location (Mbitini location). Sixty (60) per cent of the respondents fetch water from sources within 2 kilometres compared to 44% of the respondents who were fetching water from sources more than two kilometres away before the initiation of the project.

Households in the baseline area (Yatta and Mutomo) trek longer distances compared to the ones in the already built-up catchment. In Yatta Division for example, 35% respondents trek for more the five kilometres to their main water sources while 52% trek for five kilometres or less. In Mutomo, over 55% of the respondents trek for more than five kilometres in search of this precious commodity.

Other cases show that in Kathungu and Kiangwa (Mutomo) 68% and 76% of the respondents said that they fetch water from sources more than two kilometres. In Kituti (Mutomo) 65% of the households get water from sources more than two kilometres away while 87% of respondents from Ndakani (Mutomo) get the same from sources more than five kilometres always.

In Ndakani sub-location, distances to water sources make the amount of water available to households so low such that it influences the type of food to be cooked by households. Sometimes water is so scarce such that people deviate from cooking meals whose water requirements are high. For example, cooking maize and beans *(Isyo)* becomes uncommon to

many families. Respondents reported that water has to be recycled. In the same sub-location distances to the water source are as long as 25 kilometres (one way), when there is a drought, very few donkeys survive, majority of them die on their way to or from water sources.

In Syomunyu (Yatta) those fetching water from sources more than two kilometres form 61% of the sample.

The project has made life easier for most of the residents in the project area compared to the counterparts in Yatta and Mutomo divisions. Those who were trekking for long distances to water sources are now able to get water from manageable distances, that is, less than two kilometres from their homes. The need for improvement of water sources in Yatta and Mutomo is paramount.

Time Spend in Search of Water

A household's inadequate access to water can have major adverse consequences on the length and hardship of a poor woman's working day. It also has a negative impact on priorities for family care (GOK, 2000).

To find out the impact of the project on time taken to and from water source, respondents were asked to report the time they took to and from their main water source. This time was inclusive of queuing to draw water where applicable.

Global participants data show reduced time spend on water fetching. During the wet season, time was reduced to below 1/2 of an hour. Fifty (50) per cent of participants reported shorter duration of below 2 hours.

Specific catchment data indicates reduced duration especially among the participants in both Kiindu and Ithumula catchments. For example, from Kiindu catchment, time taken to and from the main water source, before the project, and in dry season, was between 1 and 5 hours for over 50% of the respondents. After the project, over 70% households reported that the duration taken to and from water source drastically reduced to below 1/2 of an hour.

The project has reduced the time taken in water fetching in Wii catchment by a reasonable margin for before the project, those taking half an hour in water fetching were 36% during the dry season. The percentage increased to 60% after the project. Those taking one hour reduced from 32% before the project to 20% after the project. Those who used to take 2 hours reduced to 16% from 42%.

Before the project, it could take 73% of Ithumula/Maluma sub-location participants between 1/2 and 2 hours to walk to the main water source during the dry season. After the project, the frequency in this group grew bigger to 96%. In the wet season, there was no much variation in the situations before and after the project.

Similar results were obtained from the male-female segregated data. The results are presented in the table 7.5. Over 80% of households headed by males and females are now trekking less than one hour in search of this vital commodity during the dry season.

In Yatta and Mutomo Divisions the distribution of respondents as per the time spend while fetching water is shown in table 7.5. In Mutomo the time spend on water fetching in more that that spend in Yatta over the same. Those spending more than 5 hours form 21% of those interviewed. Cases of people taking two to three days to and from the water sources were reported in Ndakani location (Mutomo). This is an indicator that water searching consumes quite considerable time of the respondents. Respondents are left with very little time for other activities. In Yatta, 31% of the respondents spend more than two hours in search of water.

Table 7.4: Time Taken To And From The Main Water Source (Hours)

	Global participants data				Wii catchment				Kiindu catchment				Ithumula catchment			
	Before IWSS		After IWSS		Before IWSS		After IWSS		Before IWSS		After IWSS		Before IWSS		After IWSS	
Hours	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W
Less that 0.5	33	44	51	53	45	78	72	77	26	62	84	72	28	56	69	69
Above 0.5 and below 1	48	40	39	34	20	10	21	8	16	6	12	12	39	33	23	26
Above 1 and below 2	12	12	9	11	15	3	4.5	1	34	10	4	4	15	3	3	5
Above 2 and below 5	5	2	0	0	15	2	1.9	1	22	8	0	0	8	3	5	0
Above 5 and below 10	0	0	0	0	0	1	0	0	2	0	0	0	10	0	0	0
Above 10	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
not reported	0	2	0	0	0	7	0	12	0	14	0	12	0	5	0	0

Key: D= Dry season; W= Wet season

Table 7.5: Time Taken To Water Source: Baseline and Male-Female Analysis

	Yatta Division	Mutomo Division	Before the Sand dams		After the Sand dams	
			Male	Female	Male	Female
Below 0.5 hour	10	15	43	36	52	51
Over 0.5 to 1 hour	21	10	23	35	28	32
Over 1 to 2 hours	38	18	19	16	16	12
Over 2 to 5 hours	25	36	11	10	3	4
Over 5	6	21	4	1	1	1

Due to the shortened distances to water sources, many families in the are now able to get water nearer their homes as evidenced by the data above. Water searching is no longer consuming the largest share of time as the case was before the project. This is one of the objectives, which SASOL had set itself before embarking on the project.

7.4 PROJECT IMPACT ON TREKKING FOR LONG DISTANCES

When there is a drought and during the dry seasons, acute water shortages are reported in many parts of Kitui district. This makes search for water the major activity. People spend many hours and sometimes days either trekking to the distance water sources and/or queuing at the water

source(s). In the southern division, for example, cases of people trekking for 32 kilometres in search of water were reported.

With aim of establishing whether the improved water supply has impacted on these issues, responses were analysed to clarify issues masked by distance.

Global data from the project area indicates that 93% of the participants have a negative attitude of girls walking for long distances in search of water. They reported that trekking for long distances or spending nights in water points in search for water is risky affair for girls and women generally. Chances of being raped were high. They also asserted that the exercise is very tiring and compromises other household activities. The 3% who see the activity positively argued that the activity is a good exercise for girls and it makes them responsible. The participants reported that girls are more secure because they water is nearer their homes thus girls are no longer trekking for long distances while searching for water.

Respondents from Ithumula catchment gave the following responses; 67% of them said that security has improved, 5% asserted that it has declined although it cannot be established in what ways, 18% think that there is no change. Seventeen (17% per cent reported reduced time spend while fetching water while 5% reported cases of school drop-out have reduced after the project. Thirty six (36% per cent say that girls are more secure with 15% reporting that they have more time to relax because they are no longer spending a lot of time on sourcing for water. Majority of the respondents from all areas agree that trekking for long distances by girls while fetching water is regarded as bad.

Ninety-eight (98% per cent of the project office bearers from Kiindu catchment were of the opinion that it was bad for girls while its only 2% of them who reported that the activity was regarded as good for girls. Seventy-six (76% per cent of their counter parts from Ithumula catchment said that trekking of girls was bad with 12% regarding it as good.

Participants in Wii catchment also show a dislike for girls trekking, 72% of them asserted that it was bad with 12% of them claiming that the activity was good.

There was some variation in the male-female responses. A larger percentage of men (27) reported to favour girls walking for long distances compared to 14% of women respondents. It seems still a larger proportion of men compared to women believe that girls who walk longer distances in search of water are hard working and stand a good chance of attracting good husbands. This implies that there are some men who are insensitive to the suffering undergone by females while fetching water.

Data from Ithumula/Maluma sub-location paint a negative picture on the matter. Eighty four percent of the interviewed members said it is bad. Those who support the activity make a mere 12% of the sample (39 respondents).

In Kyangunga sub-location, the feelings of the participants on this issue are similar to those of the other areas, 77% (33 out of the interviewed 43 respondents) are in line with those who say it is bad. To 12% of the participants, the activity is good.

Respondents from the whole project area, both participants and non-participants, asserted, in large numbers, that the activity was not/is not good for girls.

Opinions were also sought about the dislike or support of the issue. Trekking of females to water sources when there is scarcity of water sometimes involves part or the whole night, this increases chances of girls and women being raped on the way. It is tiring and time consuming venture which majority of the respondents dislike as evidenced by the data. The minority supporting this activity base their arguments on the traditional method of identifying those hard working and lazy female members of society. Claims that trekking provides girls with physical exercise, girls become lazy if they don't fetch water from far are some of the reasons for asserting that this activity was/is good.

There was a slight difference between male and females responses. Twenty-four (24) per cent males concurred that trekking by girls was good compared to 14% of the female respondents.

Among all those who interviewed in Yatta and Mutomo Divisions, 85% and 91% respectively asserted that trekking for long distances is bad for the girl-child.

In Muthungue (Kyamatu sub-location) for example, more than 66% of the respondents trek for more than 5 kilometres while in Kalambani (Mutha) 75% of the households walk for more than two kilometres to the nearest water source during the dry season. In other areas people are reported to have been/ to spend/ing nights in the water sources while queuing for water. Males have to guard the females. This has been a very risky, tiring and an activity, which compromised other household duties. It was also reported that girls develop irresponsible behaviour, which lead to early pregnancies and marriages. Sometimes thugs attack women and/or girls and rape them making water fetching a very risky business for the females. When the shortage becomes acute, children are sometimes withdrawn from school to assist in water fetching.

In Yatta Division, those who reported trekking for long distances for girls being bad gave the following reasons. Nineteen (19) per cent said that girls develop bad behaviour, 3% asserted that it compromises other duties, 17% reported that it is tiring while the majority asserted that it is not generally safe for girls. Data collected from Mutomo Division indicate that 30% of the respondents are of the opinion that it leads to bad behaviour, 11% claimed that it is compromises other duties, 31% reported that it is not generally safe for girls while 20% asserted that it is tiring.

Those who reported the same as good for girls were 12% for Yatta and 9% for Mutomo. Those behind this assertion argue that trekking for long distance is a test of adulthood for girls (1%) and it's a good exercise (3%). However, as indicated by majority of the respondents, trekking for long distances is generally harmful to the welfare of girls.

There is consensus among all categories of respondents in both the project area and baseline area that trekking of girls for long distances in search of water is bad. The activity puts the lives of girls at a risk; it has a negative impact on their health, chances of being raped are high and the exercise sets a negative socialization environment for girls leading to unwanted pregnancies. The project as evidenced by the data, has managed to reduce the risks faced by girls while trekking for long distances while searching for water and girls are no longer facing the tiring journeys to the distances water sources. These risks are still faced by girls in the baseline area.

7.5 HOURS OF SLEEP BEFORE AND AFTER THE PROJECT

As discussed in the introduction, water scarcity in some parts of Kitui forces people to spend time meant for sleep in water fetching activities. Members of households engaged in water fetching activities are reported to wake up early in the morning, sometimes as early as 2.00 am, to get to water sources in time and to avoid long queues. The most immediate impact of this project was improvement in the availability of water either from scoop holes or wells. In the past, households had difficulties extracting water from scoop holes as the dry season progressed. As the water levels dropped, holes were dug deeper and deeper until there was a risk that the sides of the scoop hole would collapse and people be trapped inside (SASOL 1999).

During the dry spell there were also some additional problems resulting from the slow rate at which water infiltrates into the scoop holes. This also forced household members to wake up early to avoid long queues. It is worth to note that with diversification of water points after the sand dams, pressure was reduced from earlier limited sources, thus reducing the time spend at the water source either queuing or waiting for slow infiltrating scoop holes. A case in point is Kamale in Ithumula/Maluma sub-location.

To establish the situation after the project, respondents were asked the time they used to spend in sleep before and after the project, both during the dry and wet seasons. Responses from this question have been analysed using Pearson correlation tests. The results indicate that the relationship between hours of sleep before the project and after (dry season) was positive but somewhat weak. The strength of relationships between hours spent in sleep during the wet season, before and after; and wet season and dry season, after the project, were not significantly different. The strength tended towards a positive perfect relationship meaning that in terms of hours of sleep, the project brought almost to par the amount of time spent in sleep during dry and wet season. Analysis from Kiindu and Ithumula catchment is found in table 7.6.

Not more than 33% of the interviewed households used to sleep for more than eight hours before the project in Mbitini (Mbitini). In Ndung'uni (in Mbitini Location) participants reported that during the dry season, they used to spend nights queuing for water in the only available source. People getting water from this source had to come to an agreement on how to ration the little water among themselves. After a sand dam was constructed in the stream, the volume of the water increased to a level they have never been able to exhaust even during very severe droughts.

In Kyambiti (Mulango) and Ngangani (Kisasi) there was no significant difference in hours of sleep before and after the project. This could be explained by the fact that in some places increased availability of water increase the opportunity of production thus the saved time from water fetching activities is diverted to other social and economic undertakings.

Table 7.6: Pearson Correlation Tests Between Hours Of Sleep Before And After The Project

Period and season	Kiindu catchment	Ithumula catchment
Dry (before) and Dry (after)	0.27*	0.42**
Wet (before) and Wet (after)	0.63**	0.69**
Dry (after) and Wet (after)	0.60**	0.87**
Dry (before) and Wet (before)	0.45**	0.53*

** Correlation significant at the 0.001 level (two tailed)*
***Correlation significant at the 0.005 level (two tailed)*

Disintegrated data on gender basis indicate that before the project 41% of females used to sleep for less than four hours in the dry season compared to 4% males. Seventy-three (73) per cent of men used to sleep more than six hours. Only 5% of females used to sleep the same number of hours. After the project, the quantity of time slept changed though differently between males and females. For the males the change was not very well pronounced. On average, 78% of males could sleep for more than six hours. There was shift in the skewness with high frequencies being concentrated relatively towards more hours of sleep for the females. The percentage of females sleeping for less than four hours reduced from 41% to 25%. This indicates that the project had a relatively great impact to women compared to men. This is yet another pointer that water fetching lies on the female domain.

In Yatta Division, 47% of those interviewed asserted that they sleep for a period of between 6 and 8 hours in the dry season compared to 53% in the wet season. Those who sleep for more than 8 hours form in the dry season form 45% of the sample compared 42% in the wet season. In Mutomo Division, 6% of the respondents reported that they sleep for less than four hours in the dry season 2% in the wet season. Fifteen (15% per cent spend between 4 and 6 hours on sleep during the dry season compared to 5% in the wet season. Forty two (42% per cent asserted that they spend between 6 and 8 on sleep during the dry season compared to 55% in the wet season. Those who sleep for more than 8 hours in the dry season form 36% of the sample compared to 37% in the wet season.

The difference in hours of sleep during the dry and the wet season vary slightly in the two Divisions. In the wet season people seem to spend more time in sleep. This is partially explained by availability of water during this season. It should be noted that there are area variations depending on the availability of water.

In Syomunyu (Kanyangi) 59% of the household heads asserted that they have sleep for durations ranging between 6 and 8 hours while those in Kathungu (Ikanga location) reported that 82% of the households sleep for more than eight hours. A similar situation was encountered in Kituti (Athi location). In Kituti, 89% of the households sleep for more than six hours. Ndakani (Ndakani location) was among the extreme cases. It was reported that 33% of the households spend more than six hours in sleep.

Increased water availability releases time spent in water fetching activities. Households have the freedom to choose between engaging in leisure, sleep or economic activities.

7.6 DEPTH OF SCOOP HOLES IN EPHEMERAL RIVERS (MIVUKO)

During the dry season, water tables are low and seepage of water is low. People have to dig deep into the sand (*Kuvuka*) and the depths keep on increasing as the dry spell progresses. Cases of people having to dig for 15 feet have been reported. Owing to the instability of the sand walls, those scooping the water are put at a risk. Animals cannot access the water therefore they have to be watered. People spend a lot of time waiting to fetch water or water their livestock in the slow yielding scope holes.

The depth of scoop holes before and after the project was compared. Results are presented in the table below. From the global data, the majority (over 50%) of the participants reported depths of scope-holes in the brackets 3-5 and 6-10 feet categories. After the project, depths of scoop holes

reduced drastically. Eighty (88) per cent of the participants reported that the depth of scoop holes was below and including two feet.

For example, in Kiindu catchment, 28% and 44% reported depths in the range 3-5 and 6-10 feet respectively among the participants. Almost a similar scenario was found in Wii before the project, with 40% and 28% of the households reporting that the depth of scoop holes was in the brackets (6-10) feet and 2-5 feet respectively. Fifty-four (54% and sixty-eight (68% per cent of participants in Ithumula and Wii catchments recorded almost similar results.

In the female-male separated data, 33% and 36% of males and females reported that water was obtainable from scoop holes deeper than 5 feet. The percentage reported by men could be an underestimation because in rare cases are men involved in water fetching. After the project, 59% and 58% of males and females alluded to the fact that the depth of scoop holes was less than two feet.

Among the non-participants, depths still remain high and with a large variation. Kyangunga non-participants uniformly report depths ranging between below 2 feet to below and including 10 feet categories while Wii presents similar data.

Table 7.7: Depth Of Scoop-Holes

Depth in feet	Wii catchment		Kiindu catchment		Ithumula catchment		Females		Males		Mutomo	Yatta
	D1	D2	D1	D2	D1	D2	D1	D2	D1	D2		
Below 2 depth	12	68	4	88	5	51	12	57	11	59	8	18
Above 2 and below 5	28	16	34	10	33	18	37	15	43	15	31	35
Above 5 and below 10	40	4	48	2	46	3	29	2	25	3	13	5
Above 10 and below 15	4	0	8	0	0	0	5	0	6	1	12	42
Over 15	0	0	6	0	0	0	2	0	2	2	26	0
Not applicable/reported	16	12	0	0	16	28	15	26	13	20	10	0
Total	100	100	100	100	100	100	100	100	100	100	100	100

D1=Before the sand dam project; D2= After the sand dam project

Before the project, over 70% of the participants in Ithumula/Maluma sub-location reported the depth of scoop-holes in the range between 2-10 feet. However, after the project the depths reduced significantly to below 2 feet for over 70% of the respondents. The depth of scoop holes was also reported to have reduced in Kyambiti (Mulango).

In Ngangani sub-location (Kisasi), 65% of the participants were digging between 2-5 feet before the project while after the project those digging 2 feet and below are 80% of those interviewed. Mbitini (Mbitini) data indicates that depth of scoop hole being above 5 feet before while after the project the scoop holes were as shallow as 2 feet deep for 55% of the interviewed participants. In Kwa Muli sub-location (Wii catchment), 71% of the participants reported that they are now able to access water from scoop holes, which are less than two feet deep as a result of the construction of the dams.

The global baseline data from Yatta and Mutomo is as per the table 7.7. In Mutomo division the percentage of those sourcing water from scoop holes whose depth is more than 10 feet form 13%

of the respondents. This is quite high considering the risks involved in such sources for both human beings and livestock.

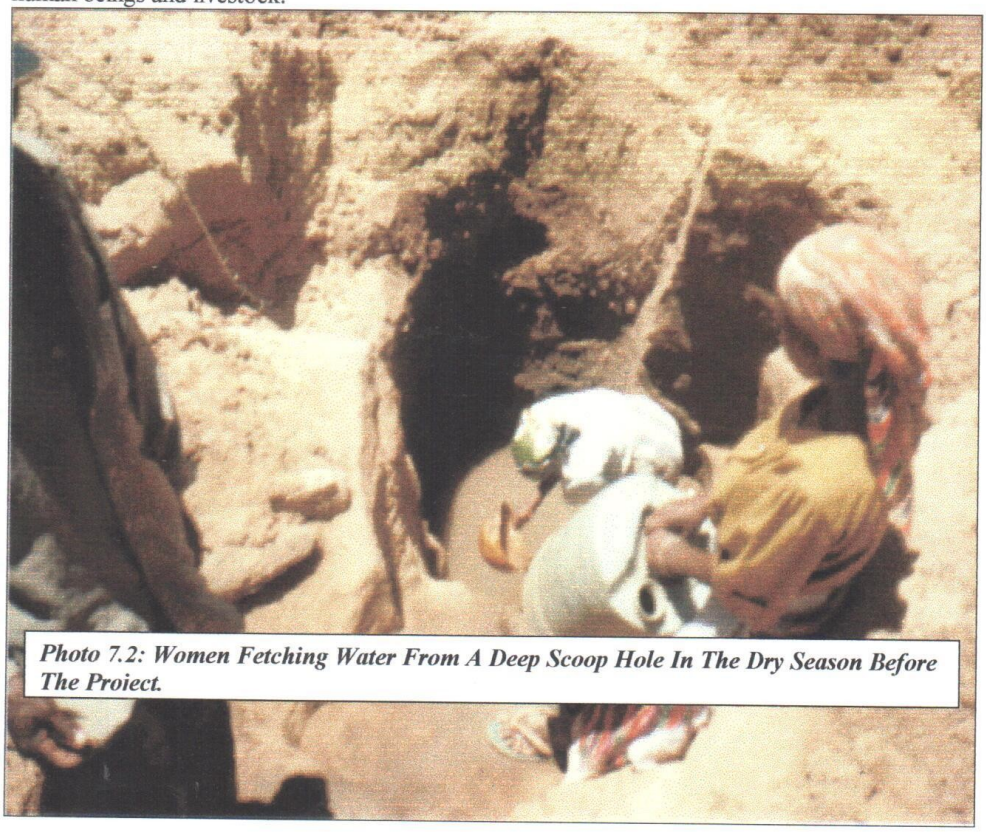


Photo 7.2: Women Fetching Water From A Deep Scoop Hole In The Dry Season Before The Project.

Comparing these observations in the baseline data, it was established that in Syomunyu (Kanyangi) 52% of the respondents have to dig between 10-15 feet to have access to water. In Kathungu (Ikanga) depth of scoop holes were reported to over 5 feet for more than 43% of the interviewed households while in Kituti (Athi) 28% of the respondents dig more than two feet to access to this precious commodity.

The construction of sand dams in the project area has reduced the depth of scoop holes to less than two feet in most areas has shown by the findings. The water table is higher than before. Thus people are able to access water without difficulties. This has also reduced the risk posed by the collapsing of the walls of the scoop holes. The shallow scoop holes require only one person to access the water compared to the situation before. See photographs 7.2 and 7.3 for further illustration.

7.7 WATER RATIONING

Cases of water rationing before the project was reported in the four catchments but is related to queuing at the water source and fixed amounts of water to be fetched by households in a day.

Global participants data shows that there was water rationing before the sand dams were constructed. Thirty-one (31%) percent of the participants reported so. After the project, the percentage reduced to 3%.

On average, only 10% of the households reported water rationing in Wii and Kiindu catchments. In Ithumula/Maluma catchment, 51% of the participants reported water-rationing incidences before the project. Only few cases (less than 2%) of water rationing are reported after the implementation of the project in the three catchments during the extended dry spell.



Photo 7.3: A Girl Scooping Water From A Shallow Scoop Hole, Kiindu River

In Mbitini sub-location, water rationing seems to have reduced by a significant margin. Respondents (28%) said that before the project, there was rationing. After the project a mere 7% reported so. Residents living in the proximity of Ndunguni sand dam reported that during severe droughts they used to spend days and nights queuing for water in the well, but after the sand dam

and a well was constructed in the stream, the amount of water has increased to a capacity they have never exhausted since then.

The phenomena of water rationing are more pronounced in Mutomo Division. Three (3) per cent of the respondents reported that they queue for water during the dry season while 28% are limited to a fixed amount of water in a day.

In Yatta, 5% of the respondents reported cases of water rationing. Sub-location data show that in Syomunyu water rationing is reported by 13% of those interviewed. A similar percentage is obtained from Kathungu sub-location where 17% of the interviewed household heads reported water rationing. They said that households are restricted to a fixed amount of water per day.

Ndakani sub-location (Ndakani location) reported alarming levels of water rationing as 47% of those interviewed reported that water has to be rationed owing to its scarcity in the area.

From the above, it is evident that the project has reduced water rationing in the project area by a big margin. This has an impact on the sanitation of the participants. Water rationing compromises quality of sanitation in households, many household members are forced to go without taking a bath for days while water has to be recycled. After the project, participants are able to consume more water than before compared to the baseline area, where water rationing is pronounced as discussed above.

7.8 QUALITY OF WATER

Due to water scarcity in Kitui District, emphasis is hardly put on its quality when obtained (Akong'a, 1985). It has been established that provision of high quality water can reduce significantly incidences of waterborne diseases (Kimuyu, 1995). Thus it was found necessary to analyse the quality of water before and after the sand dam project, even though quality was not among the project's key objectives.

Respondents were asked to describe the quality of water from their main source in dry and wet seasons using three senses namely, sight, taste and smell. From the results, it was established that over two-thirds of the respondents described their water quality as clean, clear or good, before and after the project. The remaining third described their water quality as dirty or coloured with some describing it as having a bad smell, before and after the project.

From the global data, water quality for majority (over 65%) of the participants was reported to be good before the project. The project interfered positively with the water quality. After the project 7% more households said that their water quality had improved.

There was no marked difference in water quality before and after the sand dam project in Ithumula catchment. Over 80% of the respondents described the quality of water from their main source as clean, clear and generally good. Only a small percentage described its water as dirty, coloured and having a bad smell.

Participants from Kiindu (5%) and Wii (4%) catchments reported that quality of their water was salty during the wet season after the project.

Table 7.8: Quality Of Water From The Main Water Source

Quality	Kiindu				Wii				Ithumula/Maluma			
	Before IWSS		After IWSS		Before IWSS		After IWSS		Before IWSS		After IWSS	
	D	W	D	W	D	W	D	W	D	W	D	W
Clean/clear/good	65	72	76	69	72	72	80	92	79	86	84	89
Dirty/coloured/bad smell	32	20	23	20	28	24	20	4	7	11	3	7
Salty	0	4	0	0	0	4	0	4	9	1	10	1
Other	2	2	0	2	0	0	0	0	0	0	0	3
Not reported	0	0	0	7	0	0	0	0	3	1	1	1
Total	100	100	100	100	100	100	100	100	100	100	100	100

Key: NP= Non-participants; P= Participants; D= Dry season; W= Wet season

Results supporting improvement in water quality are obtained when the data is analysed on male-female basis. Seventy-two (72) percent of male respondents said that their water quality was now clean, compared 70% of them before the project. A relatively high percentage of females (78%) reported good quality water compared to 76% before the project. The percentage reported by women is more reliable because women visit water points and are in position to make comparison between what is considered clean and what is not.

Cases of water becoming salty were reported but to a lesser extent. In Mbitini (Mbitini) one of the most striking observations was that 52% of the respondents reported that water quality from their main source was salty after the project. This percentage is attributable to the marked shift from reliance on distant earth dams to near source availed by the construction of the sand dams.

In Yatta Division 45% of those interviewed, described their water as clean/clear, 35% described it as dirty, while 3% reported that their water is salty. In Mutomo Division, 40% of the interviewees described their water as clean/clear, 9% said they have access to dirty water while the highest percentage, 50% of the respondents asserted that that their water salty.

Sub-location data show that those fetching water they describe to as clean in Syomunyu (Kanyangi) composed 50% of the respondents while 47% reported that they only have access to dirty water.

In Kathungu (Ikanga location), respondents described their water from the main water source as clean (76%), dirty (14%) and salty (10%) while in Ndakani the percentages of respondents asserting access to clean water was 87%

Although water quality was not one of the objectives SASOL while embarking on the project, data shows that the project have had a major impact on the quality of water consumed by the people in the propjet area.

7.9 LEVEL OF SAND DAM UTILISATION AND SATISFACTION

Accessibility

In providing an improved water supply system, accessibility to the facility is of paramount importance. Participants were asked to comment on accessibility to their nearest sand dam. Over 70% of the respondents described their water sources as accessible. For example, in Kwa Muli (Katulani), 94% participants reported that the sand dams are accessible.

Few cases of misunderstanding were reported, in Mbitini for example, members asserted that a certain member had privatised the dams owing to the fact that they are constructed on his land thus denying the other members the use of the facility. Other similar cases reported were those concerning the use of the adjacent land for production purposes. It is logical that the members owning the land adjacent to the dams are bound to reap more benefits than the rest. This makes the other members feel that the former group is benefiting from the project than the latter.

Respondents from the four catchments reported that after the construction of the sand dams, they don't need to fetch water at a common point especially were the dams backed up. Some dams backed up for more than 2 km. In this case respondents scope from the nearest point to their homes.

In the female-male separated data, 78% and 77% of males and females respectively, reported that the sand dams were accessible.

As far as accessibility is concerned, there were no major problems except in some isolated cases.

Utilization and Satisfaction

Were the participants' efforts rewarded according to their expectations? Was the cost worth it? To answer these questions, we looked at the satisfaction level and sought to establish whether the participants had shifted from their traditional water sources. The results are presented in the table below.

From the table 7.9, it can be seen that most of the participants were satisfied with the project. Reasons for non-satisfaction were reported inter alia: dirty water, drying up of wells, dams washed away by the *el nino* rains, no opportunity for multiple use and privatisation of the dams.

In Kathungu (Ikanga) depth of scoop holes were reported to over 5 feet for more than 43% of the interviewed households while in Kituti (Athi) 28% of the respondents dig more than two feet to access to this precious commodity.

The construction of sand dams in the project area has reduced the depth of scoop holes to less than two feet in most areas has shown by the findings. The water table is higher than before. Thus people are able to access water without difficulties. This has also reduced the risk posed by the collapsing of the walls of the scoop holes. The shallow scoop holes require only one person to access the water compared to the situation before. See photographs 7.2 and 7.3 for further illustration.

Table 7.9: Satisfaction Levels

Sub-Location/Catchment	Satisfied (%)	Shifted (%)
Ithumula catchment	87	72
Kiindu catchment	90	78
Kisiio catchment	84	87
Mwiiwe catchment	86	82
Nzangathi s/location	77	31
Kyangunga s/location	74	50
Wii s/location	88	48
Kyanika s/location	55	33
Ithumula/Maluma s/location	89	64
Ngangani s/location	57	56
Masimbini s/location	45	50
Ngiluni s/location	83	67

From the table also, it can be noted that on average over 50% of the participants shifted from their traditional water sources. Those who did not shift gave the following reasons for their behaviour: traditional water sources being nearer, no opportunity for multiple use, and that sand dam site coincided with traditional communal water points.

Similar results were obtained from the female-male disintegrated data. Eighty (80) per cent of males and females reported that they were satisfied with the project with majority shifting from their traditional sources of water.

This analysis indicates that majority of the people who participated in the sand dam project were satisfied and their efforts bore fruits.

7.10 GENERAL SOCIAL AND ECONOMIC IMPACTS

To elicit information on the overall impact of the sand dams project, participants in the catchments were asked to mention the changes, which had occurred after the project. Respondents were not supposed to be prompted or led in giving their responses.

Over 80% of the participants recorded increased water supply in the three catchments. Regarding distances travelled to their main water source, over 70% of the participants in Kiindu and Wii revealed that distances had decreased.

In Ithumula/Maluma catchment however, only 45% reported reduced distances. A new dimension, which was not expected and therefore not contained in the questionnaire, was observed. Many residents reported that although their distances to water sources have not reduced as a result of construction of the sand dams, the time they used to spend in the shallow wells was greatly reduced. The detail point is that the construction of the sand dams reduced the pressure previously exerted on the few shallow wells in the village. It should be further noted that respondents reported that they have been relieved the burden of fetching water for the purposes of watering their animals at home. After the construction of the dams people are able to water their livestock at the sand dams. Those interviewed from this sub-location also said that they own personal water sources unlike before the project when they were at the mercy of individuals who owned wells. The technical point is that the dams recharge a wide area from which individuals

can develop their own water source. Apart from availing water in the streams, the dams have already led to recharging of wells thus increasing water yields in the old wells and making it possible to have wells in areas which did not have wells before the project. Documentation of the recharge of the water table is now afoot and a technical report will be produced towards the end of 2002 by TU Delft University.

More than half of the respondents in the project area reported increased vegetable growing and kitchen gardening.

In Kyangunga and Kyambiti sub-locations, 70% of the participants reported increased brick making activities while in Ithumula/Maluma sub-location; only 28% reported the same. Similar findings were recorded as far as livestock watering is concerned. More than half of participants in Kyangunga and Wii sub-locations recorded increased livestock watering, Ithumula/Maluma sub-location recording a 31% increase. The low percentage is attributed to the fact that some of the residents do not practice livestock farming due to the high population densities in some of the areas like Kamale village thus its only those few respondents rearing livestock who reported an increase in livestock watering.

Other increasing activities include bee keeping, seedling nurseries and terracing. Fishing was reported in Kiindu and Ithumula catchments although it is more pronounced in Ithumula catchment particularly in Kamale village Ithumula/Maluma sub-location. It is a transitory activity for as the sand dams fill with sand it will cease.

From male-female responses, 84% and 87% of females and males respectively reported that more water was available as a result of the project. According to 46% of the female respondents distance to water sources had reduced while 49% of their male counterparts reported the same. There were no marked differences between male-female responses in the other reported aspects such as kitchen gardening, vegetable growing, brick making, body washing, etc.

When dam committee members from Kiindu catchment were asked to mention the ways in which the increased water supply has affected them, 84% reported improvement in health, 6% reported a decline in health while according to 6%, the health situation in the area has remained the same. Ninety four percent of those interviewed have witnessed improvement in cleanness, 2% reported that cleanness has declined.

All the respondents reported a change of some kind. Concerning leisure, 70% of the participants members reported that leisure has increased, 18% think it has declined while 2% argued that they have not observed any change so far. Nineteen (19)(36%) respondents with school-going girl-children reported a decline in school absenteeism while 13(26%) of them argued that the situation is the same. Two (2) per cent recorded increased absenteeism. There are no significant differences between boys and girls. Improvement in girl-child punctuality was recorded from 27% of the respondents while 10% argued that the situation has not changed. Only one dam committee member said that there has been an increase in girl child absenteeism. There is no notable difference between the girl-child results and the boy-child results on the same issue.

Ninety four (94) per cent (42 members) of the interviewees asserted that cooking is now done at the right time. One (2%) and four (8%) of the members reported decline and the no change respectively.

Data obtained from the office bearers (dam committee members) from Ithumula gives results similar to those of their counterparts in Kiindu catchment. Improvements were reported as follows: health, 69%, cleanliness, 87%, and leisure, 51%. Decline in girl and boys absenteeism, 31% and 33% respectively.

Due to distances and time spend in search of water, school going children were involved in water fetching which forced them to report to school late. Forty one (41) per cent of the dam committee members said that there has been an improvement in punctuality for girls and 48% for boys. Seventy seven (77) per cent of the dam committee members from this catchment asserted that cooking is now been done at the right time.

Participants in Kyangunga sub-location gave responses distributed as follows; 35% reported improvement in health, 65% said that there is improvement in cleanliness, 65% have witnessed increase in leisure time.

On the issue of girls' absenteeism from school, 25% say that they have noticed a decline with 18% of the same for boys.

School children are more punctual after the improvement in water supply as evidenced by the data; 37% of the participants asserted that girls are more punctual in reporting to school than before while 35% was recorded for boys.

The level of improvement in cooking at the right time in Wii was less (51%)compared to that of participants in Kiindu catchment (95%) and Ithumula (77%).

Participants from Ithumula catchment data (62%) per cent reported having noticed improvement in health, 73% improvement in cleanliness, 51% reported increased leisure time, 27% said that girls' absenteeism has declined while 42% think it's the same as before, a similar figure is obtained for boys. Punctuality for school going children was reported to have improved for both boys and girls by 35%, the percentage for decline are less than 3% for both boys and girls. Concerning food preparation, 66% said that they are able to cook at the right time due to availability of water nearby.

Wii catchment participants' data bear a trend characteristic of the other two catchments. Seventy-six (76%) per cent claimed that health has improved, 84% have observed improvement in cleanliness in the people of Wii, while a very high percentage (80%) said that the project has made it possible for them to have some leisure time.

Data from all the participants clearly indicates that the project has affected community cohesiveness in different ways. In some areas the start of the project kicked up the process of community integration while it is likely that in other areas the shortened distances to water sources lead to separation of catchments thus leading to reduced interaction among community members especially women.

Sixty five (65) per cent of the participants from Ngangani (Kisasi) sub-location asserted that their coming together to build the dams has increased their cohesiveness while 20% of participants from Wii Sub-location reported increase in community cohesiveness. Twenty (20) percent of the interviewees (participants) from Wii sub-location asserted that they have witnessed an increase in community cohesiveness as a result of the implementation of the project.

The lowest percentage of positive impact on community cohesiveness was recorded from participants from Ithumula/Maluma sub-location. Cases of reduced community cohesiveness were reported in Kyangunga sub-location (11%), 10% from Wii sub-location, while 13% Ithumula/Maluma sub-location participants reported reduced community cohesiveness as a result of community embarking on the construction of the sand dams.

In cases where decline in health was reported, it may be resulting from the stagnant water, which is collected in the dam before the dam is filled with sand. It is plausible that the water is attracting mosquitoes (a malaria vector) thus increasing instances of the disease in those areas. The same may obtain for the waterborne diseases like typhoid. On the other hand it was established that some people think that the sand dam water is so clean that they don't take any precaution while using it.

8.0 ECONOMIC IMPACTS

8.1 USE OF THE SAVED TIME

Nearness to water source improves people's welfare and releases their time and energy for other productive activities as alluded to by the Sixth (6^{th}) National Development Plan 1989-1993 (Republic of Kenya, 1994). After an individual has travelled for say eight kilometres or more carrying water, or accompanying a donkey/donkeys or cart, her/his productive capacity is significantly reduced. This is because of the expended energy and the consumed time (Mutie, 1993).

Reduction in distance to water sources is seen as an improvement on ones welfare since the time earlier wasted can be used more constructively in the household. This tallies with Jones (1980) observation that greater accessibility to water improves the quality of life. It also resonates with Dadfields (1971) observation linking water supply to positive socio-economic changes, particularly improvements in peoples' welfare, and in some cases, agricultural production. It has been convincingly argued that women spent nearly 50% of their time carrying water, which is a tremendous waste of time, energy and resources in water scarcity areas (Henry 1977; Lindner 1991).

As result of reduced distances to water sources, people are spending less time in water fetching activities. A major objective of this study was to establish how the saved time is used. Data indicates that the saved time is used in different activities. Most of the respondents reported that they use extra time tilling their farms, some in their kitchen gardens; others have set up tree nurseries while others are able to look after their livestock. Some respondents also reported that they spend the extra time in their businesses. During the dry season some people have directed the extra time to brick making. There is also a group of the respondents who are able to have some leisure time.

In the participants global data, 16% of the participants reported that they put the extra time in their farms while about 8% devote this time to activities like brick making, kitchen gardening, seedling nurseries tending

In Kiindu catchment, 34% of the participants asserted that they spend the extra time in their shambas while 26% of their counter parts from Ithumula catchment reported that they use the time in the same ways. Participants from Wii (52%) said that they use the extra time tending their farms.

Putting the extra time saved by reduced distances to water sources to kitchen gardens is the most attractive option to (48%) of the dam committee members from Kiindu catchment. Their counter part office bearers from Ithumula (18%) are using the time in the same activity. Similar results are obtained from Mbitini (Mbitini) and Kyambiti (Mulango).

A smaller percentage revealed that they directed their created time to other social activities like attending funerals, *harambees*, markets, visiting friends, Mwethya, parties, and religious activities.

Data analysed on male-female basis indicate that 37% of the males spend their extra time in their shambas while 19% of them reported increased leisure activities. These leisure activities by men are reinforced by increased incomes accruing from the new economic activities resulting from the project. They include current affairs and political discussions and beer taking. Forty-one (41) per cent of females commit this time to *shamba* work while 9% opt for leisure. Leisure activities for women include hair-do, discussing their household welfare issues with other women.

Diversion of saved time from tedious water fetching activities is a positive externality of the sand dam project. If the incomes resulting from these activities could be given a market value, it goes a long way in improving the incomes and welfare of people living in the project area.

8.2 EXPANSION AND INTRODUCTION OF NEW ECONOMIC ACTIVITIES

Expansion of Existing Economic Activities

The most significant sand dam impact is the transformation of production as presented in table 8.1. With increased quantity of water, the local people grow kale *(sukuma wiki)*, tomatoes, onions, and varieties of improved mangoes, bananas, and sugarcane. Bee keeping, horticultural crops' nurseries and tree seedling nurseries are also new activities. Fishing, which was uncommon in the area, is a new economic activity. Brick making is on the rise.

In summary, as portrayed by the above table, crop farming is the most dominant economic activity undertaken by almost all the respondents before and after the sand dam project. Goat/sheep rearing follows crop agriculture. The other common economic activity is cattle keeping. In some catchments, a small number of respondents were engaged in brick making, vegetable growing, kitchen gardening and tree nursery tree activities before the project. This can be possibly explained by low water quantities, slow scoop-hole infiltration rates before construction of the sand dams. Water was limited to domestic uses to a large extent. After the project, as it can be deduced from table 8.1, increased quantities of water meant more water for production purposes.

Table 8.1: Economic Activities Before And After The Project

Economic Activity	Yatta	Mutomo	Ithumula		Wii		Kiindu	
			Before	After	Before	After	Before	After
Agriculture	96	79	87	78	92	80.0	98	98
Goat and sheep keeping	73	12	33	31	56	56	22	30
Cattle keeping	16	45	21	28	32	28	10	12
Vegetable growing	5	4	23	44	16	40	8	22
Kitchen gardening	9	3	13	15	8	20	8	10
Brick making	4	7	3	13	32	24	4	8
Tree Nurseries	4	2	21	23	0	12	20	32
Bee Keeping	13	15	15	18	4	12	6	6

More people started growing vegetables for sale and personal consumption. Brick making became a major economic activity to some respondents in Ithumula and Kiindu catchments. In Wii, the number of respondents engaged in brick making reduced from 32% to 24%. This could

be explained by the fact that vegetable growing became a major economic activity, almost catching up with goat/sheep and cattle rearing. Bee keeping also became an economic activity in Ithumula and Wii catchments. In Kwa Muli (Wii catchment), 19% of the participants reported that they have started bee keeping after the project.

In the baseline area (Mutomo and Yatta), the commonly reported economic activities were subsistence agriculture, goat/sheep and cattle and bee keeping. Vegetable growing, kitchen gardening, tree nurseries and brick making were undertaken though at a very small scale.

New Crops And Activities

The project triggered new activities in the three catchment areas. The most prominent among these activities is *Sukuma wiki* growing. From the participants' global data, 44% of those interviewed reported *Sukuma wiki* growing as not only a new activity but to boot the crop is also new in the area, while 10% reported tomatoes and spinach growing in the project area.

In Wii, Kiindu and Ithumula catchments, it was reported by 64%, 6% and 60% of the participants respectively that *Sukuma wiki* growing is a key economic activity after the construction of the sand dams. Other respondents (both participants and non-participants) specifically mentioned spinach, *sukuma wiki (kale)*, onions, tomatoes and ndania (coriander) as having been introduced in the project catchment area as can be observed in the table 8.2.

Fishing which was uncommon in the area was also reported but is more pronounced in Ithumula and Kiindu catchment. This is a transient activity for when the dams fill with sand, the re will be no fishing.

Sugar cane is becoming an important economic activity in Mbitini and Ngangani sub-locations. Growing of arrowroots is also picking up in most areas. Ngangani sub-location reported the highest (18) per cent among the reported cases of fruit growing as a new activity followed by Mbitini, 14%.

Table 8.2: New Crops And Activities

New crop/activity	Participants (Global)	Wii	Kiindu	Ithumula
Spinach growing	10	8	6	15
Fishing	11	4	16	13
Sukuma wiki	44	64	6	60
Onions	6	8	6	5
Tomatoes	10	12	2	18
Ndania	4	0	8	5
Sugar cane	5	8	0	8
Arrow roots	1	0	4	0
Fruits	6	4	6	8
Other crop	5	4	7	5

Brick making is on the rise in most areas where sand dams have been constructed. Mbitini reported 23% increase. In Ngangani sub-location, brick making was reported by 29% of the households as a major activity after the project compared to 11% before the implementation of the project.

In a nutshell, it should be noted that some of these activities would expand while others will disappear with time. Fishing is bound decline as the dams fill up with sand. *Sukuma wiki* growing, bee keeping, brick making are bound to increase with time. These activities are interrelated, as people's incomes increase from vegetable growing, bee keeping and selling of bricks, more decent housing will follow thus triggering the demand for building bricks.

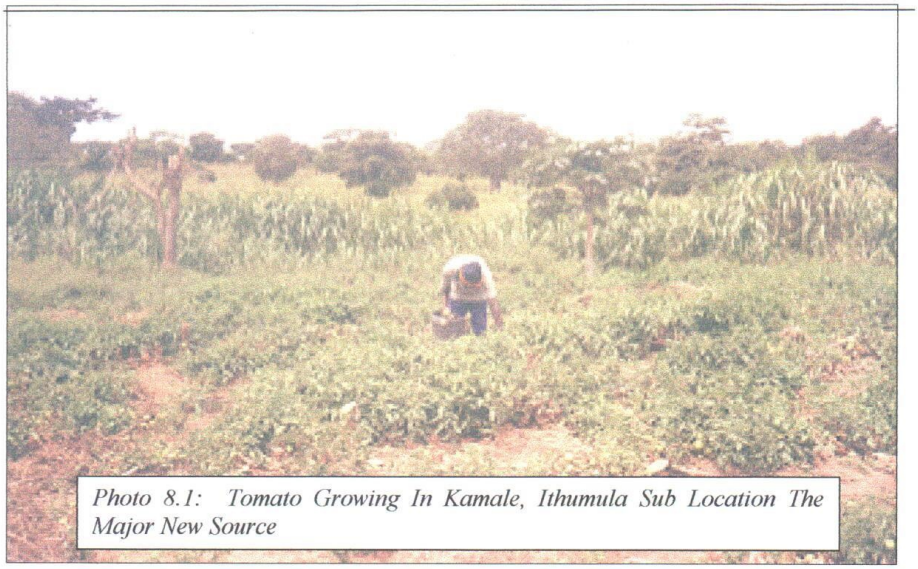


Photo 8.1: Tomato Growing In Kamale, Ithumula Sub Location The Major New Source

The level of utilization of the availed water in Kyangunga is low compared to Wii and Ithumula/Maluma sub-locations where community members have taken advantage of the availed water. They have set up income-generating projects like vegetable growing, bee keeping, Seedling nurseries, and brick making and other economic activities associated with the water. In Kyangunga sub location, majority of the productive people are involved in anti-social activities like traditional beer[11] taking which is a very common phenomenon in the area. It's not surprising to meet drunken people as early as 8 am. Casual observation shows that majority of the young people are idle. Even during the wet season, when everybody is presumed to be busy in the farms, groups of young men and women are commonly found loitering in the shopping centres, at kiosks and, along the roads.

[11] Locally known as *Kaluvu, Uki wa Kithio or Njoma*

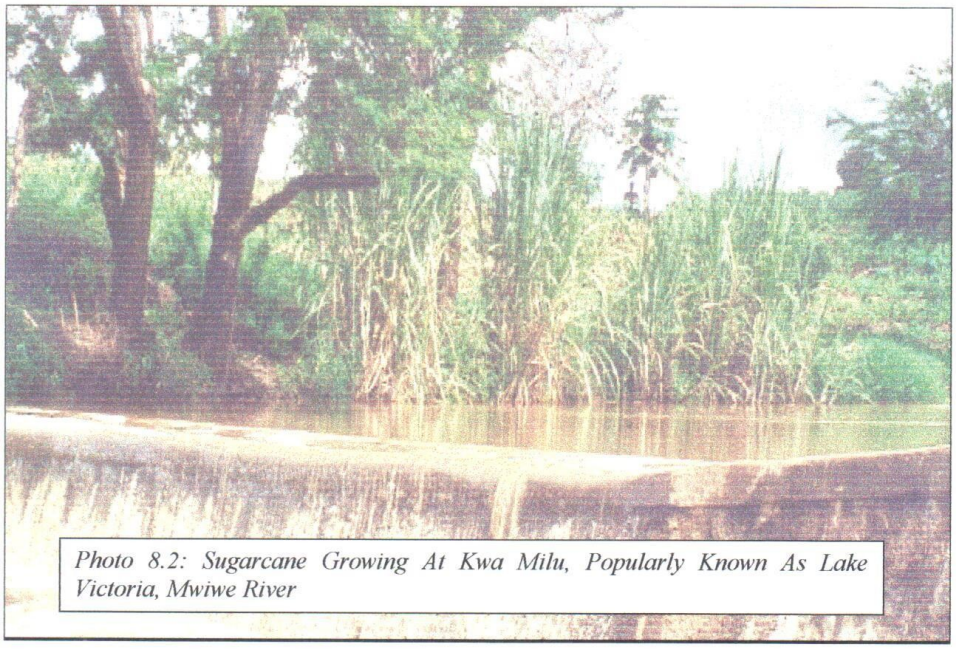


Photo 8.2: Sugarcane Growing At Kwa Milu, Popularly Known As Lake Victoria, Mwiwe River

According to Munguti (1998:91) in Ukambani inability to acquire *Kyanda* (a swampy area where crops such as, sugar cane and arrow roots can be grown throughout the year) is defined as poverty. The same seems to be the case in Kitui the rate at which most of the participants started utilising the water provide by the sand dams is an indicator to this. The swampy areas, which were created by the project, gave the participants an opportunity to fight poverty.

8.3 IMPACT OF THE NEW ACTIVITIES TO THE HOUSEHOLD INCOMES

The increased economic activities have boosted household incomes in the project area. Even though it is hard to gauge the overall contribution of this increase to the total household incomes, due to poor recording keeping, casual observation coupled with discussion with some respondents clearly shows this. Some respondents reported the kind of fixed assets they have managed to acquire with incomes accruing from the activities sparked off by the sand dam project. The data presented in Box 3 below alludes to this fact.

In year 2001, Ithumula/Maluma Sub-location, Chuluni Division, was able to meet tomato demand for Kitui town, thereby blocking suppliers from outside the district.

At this rate, this water provision technology and maximum utilization of the availed water for production will definitely reverse the vegetable and fruit supply chains in the District for it has been a net importer. Kitui District, an ASAL district has also begun to export some vegetables and fruits, mainly improved mangoes, among other products.

Data from the study shows that households owning land adjacent to the regenerated rivers are now earning over Ksh 100,000 in the dry three months of August, September and October from bucket irrigated vegetables. Income from horticultural trees is on the rise, though yet to be

aggregated and documented for the whole project area. We present data from Maluma/Ithumula sub location as an example.



Photo 8.3: Mzee David Mulela Mutua A Farmer At His Banana Farm In Kaangweni, Ithumula Sub-Location, Nzambani Location.

There are 1,969 households in Maluma/Ithumula sub-location. 38.5% of the interviewed households reported that they were engaged in vegetable planting the first year after completion of the dams. Conservatively assuming that only 2% of the households did serious planting, the first year, and further averaging down the household earned income to Ksh 90,000, with an average household having 8 people, the dry months per capita income is Ksh. 3,750. This compares to the mean income from food sales of Ksh. 125 as reported in the 1996 Welfare Monitoring Study II by CBS. The vegetable household incomes translate to Ksh 3.1 million during the first year of adoption for the entire Ithumula region. This figure is collaborated by the local councillor who estimated that Ksh. 4 m. was earned in the sub location. For the whole district, keeping the same assumptions, the dams could generate Ksh. 118 m. during the dry three months whilst using the land for other production during the rest of the year.

We should note that there was no extension effort on this new production. With these incomes, the whole district can move into a higher economic plane dramatically. Further, from a health point of view, consumption of vegetables and horticultural produce has impacted positively on health, especially of women and children. This is the way to fight poverty.

Box 7: PEOPLES' INNOVATIONS: KAMALE VIILAGE, ITHUMULA/MALUMA SUB-LOCATION

In Kamale village lives Mrs. Kavuu Kyalo (Photo 6.4), who can't hide her joy as a result of the sand dam project. "The evidence is all over", she declares. Kavuu plants vegetables (tomatoes and kale) and tree seedlings for sale. She says that she has intensified these activities by a factor of three after the sand dam project. Through selling of vegetables and seedlings, she has managed to buy livestock, build a firm house (see the photo below) worth Ksh 100,000 and meet school fees expenses. "I'm relieved of looking for casual labour to look for money to pay school fees for my children. My school going children are not send home for school fees nowadays", Kavuu states. Even though Kavuu's husband, Mzee Kyalo, never attended the training sessions offered by SASOL, Kavuu managed to teach her husband most of what was learnt. The training sessions covered lessons on food budgeting (measuring family annual food requirements, keeping enough food for the household, cooking the right amount of food and selling what is considered a surplus the right time), soil conservation (terracing, tree planting and making compost manure) and sanitation (building toilets and personal cleanliness).

Robert Mwanzia reveals that he is making about Ksh 10,000/= and Ksh 6,000 from vegetable and seedling sales during the three dry months. He says as a result of the sand dams, there is prolonged moisture retention by the farms thus increased farm output. John Kimanthi of Kaangweni village shares similar sentiments. He adds that after the training, terracing, water boiling, tree planting and vegetables planting and literacy levels have gone up among some households.

Mr. Kithome Kavivu advised that the training was appropriate for women because the courses cantered on their roles, e.g. food budgeting. It was noted that majority of the participants were men. It is only in Kyangala and Syanduini village where the number of women either equalled or was grater that that of the male counterparts.

Mzee Mutua (Photo 6.3) has 290 banana plants, 120 oranges trees, 100 pawpaws, 100 gravellia trees, 40 mango trees, 126 citrus trees, 44 castrus apple trees and 40 avocado trees. He embarked on this prosperous project after the SASOL training. His estimated annual income from bananas alone translates to Ksh 130,000. Other fruit plants are about to start bearing fruits. Mzee Mutua laments that he greatest challenge will be market for his produce.

We should note that SASOL does not have the capacity to organise extension. As part of the leadership and natural resources training for dam leaders some of the production potential is discussed. It is therefore clear that the innovations in production- utilising the sand dam water- is essentially people driven. Once a few people are trained they are able to train others informally thereby extending the knowledge. It further then be noted that such innovations are part and parcel of extensive social and production changes the full extent of which will be documented later. Perhaps part of the change is tied up with new visions and the capacity of local communities to get the message that their own development is in their hands. This is a spin-off of implementing the project in a participatory way. By so doing, SASOL has empowered the communities to design their futures.

8.4 IMPACT OF INCREASED FAMILY INCOME

Due to the increase in incomes from the availed water by the sand dams, the study wanted to establish how these incomes are impacting on the family. Seventy-one (71) per cent of participants in the project area (global) reported that the increased incomes have had positive impact. Only 10% reported negative impact of the same. According to 64% of participants from Ithumula catchment, the incomes have impacted positively on the family, 11% asserted that the impact is negative while 10% said the incomes have not affected the families in anyway.

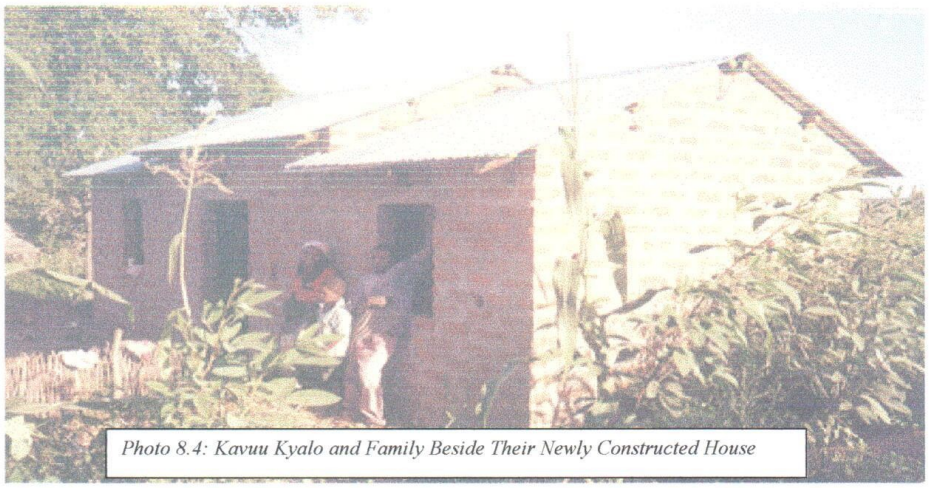


Photo 8.4: Kavuu Kyalo and Family Beside Their Newly Constructed House

Eighty-two (82%) of participants from Kiindu asserted that the increased incomes have impacted on the family unit positively, 2% said that its negative while 2% claimed that it remained the same. According to 68% of participants from Wii, the increased incomes have impacted positively on the family unit, 16% claimed that the increased incomes have negative impacts.

Table 8.3: Impact of Increased Family Income to Family Unit

Type of Impact	*Global Data*	*Ithumula*	*Kiindu*	*Wii*
Positive	71	64	82	68
Negative	10	11	2	16
The same	4	10	2	0
Not reported	15	15	14	16
Total	100	100	100	100

The above discussion shows that the benefits resulting from the sand dams have impacted on the family unit positively. The respondents reported that the income accruing from the project is used positively, that is, in paying school fees, construction of better houses, and for starting income generating activities. Very few cases were reported of negative impact.

8.5 REDUCED COST OF WATER

Increased amount of water implies reduced cost of water. Respondents were asked to give the cost of water per 20-litre jerrican before and after the project.
From table 8.4, it was found out that the cost of water was reduced with more than half of the respondents reporting a modal[12] class of below Ksh. 5 shillings. Before the project, a 20-litre jerrican of water could cost more than Ksh 20 shillings.

[12] The class with the highest frequency

The three catchments (Wii, Kiindu and Ithumula catchments) were recorded as high water cost catchments with a modal class of Ksh. 5-10 per twenty-litre jerrican before the project

Table 8.4: Cost of Water Per 20-Litre Jerrican

Ksh.	Yatta	Mutomo	Ithumula/Maluma		Wii		Kiindu	
			Before	After	Before	After	Before	After
5 and below	28	7	26	74	28	40	26	74
Over 5 -10	54	46	54	15	44	32	56	22
Over 10-15	5	15	3	3	0	0	10	0
Over 10-20	6	24	10	8	4	12	6	2
Over 20	5	7	3	0	8	0	2	0

Water, in the baseline areas (Mutomo and Yatta), remains a very expensive commodity. Cases of very high prices of water were reported in Syomunyu sub-location in Kanyangi (Yatta). Forty six (46) per cent of those interviewed said that water sells at Ksh 20 while 18% reported prices of 20 litres of water as being as high as Ksh 30 during the dry season.

In Kathungu sub-location (Mutomo) 20 litres of water goes for more than Ksh 20 as reported by 79% of those interviewed.

In Katwala (Chuluni) sub-location, 95% of those interviewed reported that they pay between Ksh 5 and 10 for twenty litres of water.

Respondents from Kyambiti sub-location (Mulango Location) reported that before the project, a 20-litre jerrican of water was costing Ksh 10 while after the project the same is costing Ksh 5.

The cost of water is also reported to have reduced by a similar margin by the respondents from Ngangani sub-location (Kisasi).

According to 41% of the participants from Mbitini sub-location (Kisiio catchment), 20 litres of water were selling at more than Ksh 10 during the dry season before the initiation of the project. Drastic reduction in cost of water is reported after the construction of the sand dams, 75% of the participants said that 20 litres of water are selling at a rate of or less that Ksh 5.

In Mosa sub-location (Chuluni), 64% of the respondents reported the cost of 20 litres of water ranging between Ksh 5 and 10 while 29% said the price ranges between Ksh 10 and 15.

It is apparent that after the sand dam project, costs of water reduced drastically. This was because of the reduced effort of fetching water by the vendors and households, which was prompted by shorter distances trekked in search of water, and lesser waiting time due to increased infiltration rates. This implies that the beneficiaries are directing the extra money they were spending on water to other needs. They are able to consume more water, which has a positive impact on their health.

8.6 IMPACT ON RURAL CENTRES: THE CASE OF MBITINI MARKET[13]

Water vendors of Mbitini market have various sources of water depending on the needs of their customers which include quantity required, nature of use and the time of the year. During the wet season, drinking water was sourced from Ilangilo- Kanyululu springs (about 4 km from the market) and scoop holes in Kisiio stream (about 2 km) before the sand dam project. However, water from Kisiio is usually salty. Large quantities of water were sourced from Nzeeu River, which is about 12 km from Mbitini town.

As the dry season encroached, water vendors would fetch both large and small requirements of water from scoop holes along Nzeeu River and Kisiio stream. "Queuing for water and water rationing was a rule", says Munyalo Kang'utu a posho mill operator in Mbitini since 1993. People were allowed to fetch a fixed amount of water in a day. "As the scoop hole became deeper and deeper, some people would queue through out the night in Kisiio stream" adds Munyalo. Due to reduced pressure as household to the east of Mbitini market turn to sand dams, Mwalimu Mwinzi Ndivo, a teacher in Mbitini Primary says Kanyululu springs also provide water during the dry season to household to the west, where the sand dam project was not implemented. "If we could get *Mingeto* along Kaveta stream (about 4 km from Mbitini), households to the west would benefit too" advices Mwalimu Ndivo.

Households or groups of related households own scoop holes. Water vendors source water from the scoop holes where their families get water to meet their domestic requirements. However, during the dry season as the water table lowers, water vendors were discouraged from fetching large quantities of water for selling.

Water for building and watering of animal during the dry season was fetched from earth dams among other sources. These dams include Kasung'wa and Kwa Kasoa. Households living near these dams would sometimes use and still use them (dams) as sources of drinking water. However, they complain, as the dams start drying-up, the water becomes greenish and acquires a bad smell even after boiling.

"Nowadays, water is not a problem in Mbitini market and the cost of water has stabilized at Ksh 5/= per 20 litre jerrican during wet and dry season", comments Mzee Mwambu wa Mwango, a businessman in Mbitini since 1957. "This is because vendors engage in price competition to capture large market share. Fresh water from Nzeeu river would cost Ksh. 15/=, but with competition from other emerging sources, the price has come down to a maximum of Ksh 10/= per 20 litre jerrican".

Water vending is purely on contractual basis with customers to ensure guaranteed market. Most of the water vendors have specific customers depending on their (customer) requirements and pays at the end of the month. It was noted that every Tea Kiosk makes arrangements with a specific supplier of water at a reasonable price. Large-scale vendors like Mzee Wanyamu Mathuku, sell water from their business premises. Mzee Wanyamu draws water for sale from Nzeeu River using a lorry.

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[13] Interview carried out on 21/01/2002

"We make water arrangements with water vendors whom we know and trust", says a Tea Kiosk respondent who sought anonymity. "Our water vendor gets water from Kwa Mung'we sand dam in Kisiio stream. We are afraid, Kwa Nzau sand dam was abused, somebody washed inside that source", she adds. Kwa Nzau sand dam is yet to be filled with sand.

Private initiatives aimed at ameliorating water problems were also reported. Some households have build water tanks to take advantage of rainwater while others more resourceful have dug ground wells. Households with excess water from wells are also selling it in Mbitini market. In Mbitini one need to dig about 47 feet to strike water. Mbitini Girls' Secondary School acquired a permanent solution to water problems by digging a private well in 1999. Before this effort, the school owned donkey-pulled cart that was used in drawing water from Nzeeu River.

Another respondent who sought anonymity reported that Kyang'aa sand dam had been privatised. The land adjacent to the sand dam has been bought and fenced by a certain individual (name withheld) who claims that the buying price was inclusive of the cost of sand dam. The land formerly belonged to Chief Mutia wa Muasya. The respondent appealed to the Government or the sponsor to intervene. This is because the sand dam remains a common good as they all participated in its construction and this incident would have a negative bearing in future as far as community participation is concerned.

Farmers along Kisiio stream supply vegetables and fruits in Mbitini market after the sand dam project. The deficit is sourced from Kalundu Market in Kitui town, but the cost has remained low owing to this other alternative source.

8.7 WILLINGNESS TO PAY FOR IMPROVED WATER SUPPLY SYSTEM (IWSS)

There seems to be variations in the amount of money which respondents wished to pay for improved water supply in the three catchments. Since the question sought answers in monetary terms, it may be useful in the future to ask the question from a labour and materials point of view which may be a more realistic way of finding out how much the community would invest in an improved water supply.

The amount of money, which respondents reported to be able to pay, is summarized in table 8.5 Majority (57%) of the participants in the project area said they would pay at most Ksh 1,000. More than 50% of the respondents quoted figures less than Ksh 1000 in the catchment specific data. This can be attributed to the low incomes in the project area.

Table 8.5: Willingness To Pay For Improved Water Supply System

Amount in Ksh	*Yatta*	*Mutomo*	*Ithumula*	*Kiindu*	*Wii*	*Males*	*Females*
Less than 500	17	50	46	32	32	55	62
Over 500-1000	7	14	18	22	20	11	8
Over 1000-5000	10	22	3	28	8	4	13
Over 5000-10000	5	3	13	8	12	8	2
Over 10000	5	3	8	10	20	0	6

Seventy (70) per cent of women compared to 66% of men were willing to pay less than Ksh 1000 for IWSS in the project area. Where water is scarce and levels of income high especially among

the rural women, willingness to pay for IWSS is high. This is because women are the ones faced by the difficulties of water fetching. This analysis becomes complicated in ASALs where levels of income are low to both women and children.

Baseline data, from Yatta and Mutomo Divisions, indicate that some of the respondents are willing to pay for Improved Water Supply System (IWSS) while others are not. These willing to pay are able to pay differing amounts as shown in the table 8.12. In Yatta and Mutomo (34%) and 92% respectively are willing to pay for IWSS. However, the amounts they are willing to pay ranges between Ksh. 500 to 10,000. Majorities of the members are willing to pay between Ksh. 500 and 1000.

In normal circumstances where levels of income are high, willingness to pay for improved water supply system increases with water scarcity. This means Mutomo and Yatta respondents were expected to quote higher figures, which was not the case. This is explained by low income earned by households in these two very dry divisions.

8.8 INDIRECT PROJECT BENEFITS

Table 8.6 shows other indirect benefits derived from the sand dam project. From the global data of the participants, 20% of the respondents reported that the cost of vegetables (sukuma wiki, spinach, tomatoes, etc) reduced drastically in the local markets. Fourteen (14) per cent reported increased land productivity owing to increased terracing and water. Other mentioned benefits include land value appreciation, increased animal reproduction rates, increased soil fertility, reduced cost of buying building sand and bricks as well as reduced cost of buying animal salt lick among others.

Table 8.6: Indirect Benefits

Type of Benefit	Participants (Global)	Ithumula	Kiindu	Wii
Vegetables- plenty and cheap	20	28	22	12
Increased sand for construction	13	21	14	4
Increased land productivity- increased water and terracing	14	8	22	12
Increased livestock reproduction rates	9	15	3	8
Soil fertility- tree planting and terracing	6	3	10	4
Able to cloth the family- increased income	6	8	2	8
Increased land value	5	10	2	4
Able to pay school fees- increased income	3	3	2	4
Reduced cost of buying salt lick for animals	2	3	0	4

In Ithumula catchment 10% and 15% of the respondents reported that their value of land and animal reproduction rates increased respectively. Respondents reported cases of people buying land after the construction of the dams are common being 36%, 48% and 40% for Ithumula, Kiindu and Wii catchments respectively. Cases of people leasing land for purposes of growing vegetables were reported as follows; 26%, 48% and 20% for Ithumula, Kiindu and Wii

catchments. Respondents reported that some non-project members pay sand dam committee members a user fee while leasing or leasing land within the dam project area.

This is another example of unintended positive outcome from the sand dam project, which also needs to be assessed in the future to determine the quantities.

9.0 MANAGEMENT FOR SUSTAINABILITY

9.1 TRADITION OF COMMUNITY ORGANISING

There are many development-oriented groups in Kitui, which can be traced to the traditional Akamba concept of *Myethya*. The table 9.1 summarises the activities undertaken by self-help groups in Kitui as found out by K.I.D.P (1992:90).

In this study, the researchers wanted to establish whether those who did not participate in the construction of the sand dams participate in other community activities.

Global data from the catchment area indicate that 67% of participants are members of other community groups.

Data from Ithumula catchment show that community members who did not participate in constructing sand dam are not interested in other community groups. Seventy-three (73%) percent of those interviewed asserted that they were not members in any community group. Only 23% of the non-participants confirmed membership in other community groups.

In Kiindu catchment, 65% of the respondents asserted that they are not members of any other groups while 30% claimed membership in the community groups.

In Wii catchment, similar results were obtained; 40% of the non-participants are members in groups while 60% are not members of any group.

There seems to be a group of people who are not interested in community work or who adopt a *"wait and see what will happen"* attitude before they participate in the project. As evidenced by the data, those who did not participate in the project were not members in other community groups. During data collection, most non-participants (in the project area) requested to be assisted after seeing the benefits realised by those who participated in the project.

This data is problematic to the implementing organizations for it limits the speed and coverage of participation of projects. SASOL has experienced this problem particularly in the first catchment constructed- Kiindu. Of course other data scattered in different parts of this report show that Kiindu has social anomie.

9.2 PERSON CONSULTED BEFORE PARTICIPATION IN THE PROJECT

A question aimed at establishing the person responsible for decision-making about joining the project was included in the questionnaire. This was important given that in Kitui, 60% of the households are female headed (SASOL working figure, although the interview data suggests that only 50% households are female headed on average) owing to various factors: males migrate to other areas in search of employment during drought and famine. Going by this figure, if women have to consult their husbands elsewhere, before they decide whether to participate or not, it would take long to mobilise the community members. The results show that participants consulted different people before they made a final decision on whether to participate in the project or not. The most commonly consulted people were husbands in the household, husbands elsewhere, wives in the household, wives elsewhere, friends and provincial administrators. The person consulted varies from place to place.

Table 9.1: Group Membership And Activities

Activities Undertaken	*Frequency*
Working in each other's shambas	17
Soil conservation activities	14
Contributing money to each others in turns (money go round)	9
Goat rearing	8
Building Schools	7
Dam construction	6
Giving loans to needy members	4
Paying school fees for needy members	4
Constructing iron-roofed houses for members	4
Rearing poultry	4
Buying utensils for each other	4
Digging latrines for each other	3
Making *Kiondos*	3
Water tank conservation	3
Working on tree nurseries	3
Burying the dead	2
Construction of rental houses	2
Bee keeping	1
Buying clothes for each other	1
Making furniture	1
Vegetable growing	1

Source: K.I.D.P (1992:90)

Among the participants from the project area, data shows that 10% consulted the local administration, 17% consulted their husbands in the households while 7% consulted their wives and husbands elsewhere. Twenty-seven (27) per cent of the participants consulted their friends.

In Kiindu catchment for example, majority (32%) of the participants consulted friends, 20% made the decision without consulting anybody, 16% consulted their husbands in the household, and 12% sought opinion on the issue from their wives in the household. Significantly none consulted their husbands elsewhere.

In Ithumula catchment, most participants consulted the provincial administration (21%), and the same percentage (21%) made the decisions by themselves. 18% discussed the issue with friends. The number who sought opinion from their wives in the household (12%) is almost the same as that of Kiindu. Those who consulted their husbands in the household form 5% of the interviewed sample. Very few men who are dam committee members (5%) consulted their wives residing elsewhere for their opinions before they participated in the project. An equally small number (3%) consulted their husbands living elsewhere for the same.

Table 9.2: Person Consulted Before Participating In Community Development

Person	*Participants-Global*	*Wii*	*Ithumula*	*Kiindu*	*Yatta*	*Mutomo*
Husband in the household	17	30	5	16	40	32
Wife in the household	7	10	12	0	17	29
Wife elsewhere	4	0	0	12	3	0
Friends	27	30	18	32	16	7
Local provincial Administration	10	10	21	0	0	11
None	20	20	21	20	0	7

Data from Wii catchment indicate that participants consulted their husbands in the household and friends (30% each). Local administration and wife in the household scored 10% each.

In the female-male separated data, women participants (36%) sought advice from their husbands in the household. Only 4% consulted husbands working in towns or elsewhere. This means women with husbands working outside their households are empowered to decided on their own, or probably with help of friends and provincial administration whether to join projects or not. Compared to females, a lesser number of males sought advice from their wives either in the household or living elsewhere. This means very few men consult their wives in decision-making. They prefer to consult friends and local administration before they join in projects.

Table 9.3: Person Consulted Before Participating in Community Development- Male-Female Data

Person	*Males*	*Females*
Husband in the Household	0	36
Husband living elsewhere	0	4
Wife in the household	19	0
Wife living elsewhere	1	0
Friends	17	20
Local administration	15	20
None	15	12

In Yatta and Mutomo, over 30% of the female respondents consulted their husbands in the household before committing themselves in project while 17% of males consulted their wives.

As shown in the table 9.3, most respondents consult their husbands or wives before embarking on any community development project. Friends and the local provincial administrators form a sizeable percentage of those whose opinion is sought before they participate in any development project. This is important for any development. This is the entry point and the concerned parties have to be given their due weight if the project has to receive community support.

The time taken by community members to decide whether to participate in a project or not decides the rate at which the project will be implemented. If women have to consult their husbands residing elsewhere, it will take more time compared to a situation whereby the woman has a right of making the decision herself.

9.3 DAM COMMITTEES

Eligibility Conditions For Dam Committee Membership

The researches were interested in identifying the main factors considered by the members while choosing dam committee members.

The most important factors that came out clearly are; ability to lead, maturity, honesty, hard work/commitment/participation/active as reported by the participants from Ithumula catchment.

According to participants from Kiindu sub-location, they consider ability to lead, good communication skills, maturity, participation/commitment, honesty and respect as the most important qualities for leaders.

For participants from Wii catchment, the ability to lead, transparency/honesty and maturity are the key factors they looked at while choosing the project office bearers. This question was not posed to the committee members.

It is evident that the project members have a clear vision of the attributes their leaders should have. This implies that they know the role played by leadership in determining the success of their project.

Choice of Dam Committee Members

KIDP (1992), listed attributes community groups consider while choosing their leaders. The most desirable quality for a chairman was reported as a loving person (as reported by 11 out of the 30 respondents) followed by kindness (as considered by 9 respondents). Seven (7) interviewees reported age as significant. Patience, sympathy and generosity had the same score (6 respondents) while God fearing, politeness and oratory power scored 5 each.

The most desirable factor considered while choosing a secretary was literacy. Other attributes, which were mentioned, though to a lesser extent were good listener, honesty, sociability, patience, faithfulness, love and devout Christian. For the Treasurer, the most desirable attribute was reported as wealth, obviously a proxy for security of contributions. The other seemingly important requirement was reported as literacy. The other attributes, which were reported, were commitment to the Christian faith, politeness, sociability, and mature people without small children.

The method used in choosing these leaders included election, selection, and appointment. Generally, there is no common procedure of choosing leaders (KIDP, 1992) for community development programmes in Kitui.

There are different methods of choosing community members to be trusted with management of rural development projects. The methods used by either the community members or a development agency weighs heavily on sustainability of the project. In cases where unpopular leaders find the way into management positions, chances of failure have proved to be very high. Where community members are given the chance to determine the people to lead them, chances

of project sustainability are high owing to the high sense of ownership by the community members.

SASOL gives the community the chances of deciding who has to lead them without any interference. SASOL gives a guideline on the characteristics of the composition of the committee. These guidelines specify the importance of electing people from all age groups, sexes, education levels, religious beliefs and political party affiliations. From this point on, SASOL leaves the decision totally in community hands.

From the participants' global data, it was established that the choice of dam committee members is by selection (44%) or election (48%). However, over 8% did not report how dam committee members are chosen. Among those who knew reported that the participants do the selection or election of dam committee.

In Wii catchment, positions of dam committee members are filled through the following methods nomination (32%), election (36%) or selection (32%). Over 60% of the participants seemed not to know how the processes of recruiting dam committee members is done. Among the 40%, some reported that dam committee members or provincial administration carry out the process. The same confusion is characteristic of the other two catchments.

In Kiindu catchment, 54% of the participants asserted that they elect the dam committee members, 16% said they are nominated while 40% claimed that the dam committee members are selected. Sixteen (16%) per cent the participants asserted that the community nominates dam committee members while 2% said that the nomination is done by the provincial administration. Forty-four (44%) per cent of the participants said dam committee members are elected by community members. Thirty (30%) per cent of the participants in Kiindu catchment said that dam committee members are nominated by the provincial administration.

In Kyangunga sub-location choice of dam committee members was found to be through selection (38%) and election (30%). Over half of the respondents seemed not to know how the committees are constituted or who actually does the election and selection. On average 15% of the participants reported that the provincial administration and dam committee members do selection!

In female-male disintegrated data, it was established that 49% and 42% of the males and females respectively reported that dam committee choice was through election. Forty-one (41%) per cent of females and males said that dam committee are selected.

Respondents were asked the duration that the dam committee members stay in office. Thirty-three (33%) per cent dam committee members and 21% of the participants in Kyangunga reported duration of half-year and one month respectively! The remaining percentage recorded that the duration was either one or two years or indefinite!

In Wii sub-location, 36% of the participants reported one-year duration while 28% reported that it was indefinite or not stated.

The percentage of participants registering unspecified duration in office was 59% in Ithumula/Maluma sub-location. Others reported durations in the range of one month and two years.

In Yatta Division only 5% of the respondents reported having water source committees while in Mutomo Division 76% of those interviewed asserted that they have water source committees. The existence of water source committees in Mutomo division can be traced to several sources according to respondents; one due to scarcity of water ion the division, the traditional water control mechanisms (through the women of Kathambi cult) has been trusted with care of water sources by the community (the Kathambi women have transformed the institution into committees), two the activities of DANIDA soil and water conservation in the 1980's assisted in setting up water point committees.

Compared to Yatta division where few water source committees exist, it was established that there have been very few donors who have attempted to set up projects in the division. The Kathambi women have not formed water source committees like those of Mutomo Division although they still exercise a lot of control over water sources. For example, they resist any attempt to interfere with the water sources. A case in point is reported in Syomunyu where the Catholic Church attempted to interfere with the existing order.

Generally members seem to be uncertain of the differences between nomination, election and selection. There is need to stress on the importance of this process while implementing the project. It is also advisable to SASOL to go back to the contracted areas to strengthen the dam committees.

Dam Committee Members Tenure

One way of determining the health of a rural community development project is establishing the strength of the committee managing the project. Some of the methods of establishing the strength of a committee are through looking at the duration in which committee members stay in office and frequency of holding meetings to deliberate on the matters arising from the common good, which brought the members together. The duration, which office bearers take, before they seek fresh mandate from the members has implications on the success of the project. Short durations in office are just as harmful as extended stay in office.

To establish how whether the dam committees are functioning, a question on the duration in office and frequency of meetings of the dam members was posed to the respondents.

From the participants' global data, 58% reported that they never meet, 8% said they meet when there is need while 8% claimed that they meet once per month. Concerning the duration which dam committee members have to take before they seek leadership mandate from the members, 49% of dam committee members don't seek the mandate because their stay in office is indefinite. Seventeen (17%) per cent reported that they hold elections after every six months while 9% stated that the duration is not stated.

According to 52% of the dam committee members in Kiindu catchment, meetings are held once per month. Twelve (12) per cent reported that they never meet while 12% said that they meet when need arises. Concerning their stay in office, 68% of the dam committee members from Kiindu reported their stay as committee members is indefinite while 12% asserted that they hold elections after every two years.

In Ithumula catchment responses from dam committee members were as follows; 59% said their office tenure is indefinite while 23% reported that they do elections after every six months. In Ithumula catchment, 44% of the dam committee members reported that they meet once per month while 31% asserted they don't meet. Eighteen (18%) percent reported that they meet when there need.

The majority of Wii catchment dam committee members (56%) claimed that they meet once per month while 28% asserted that they meet when there is need to do so. Only eight (18%) percent reported that they don't meet.

It should be noted that the responses given on monthly meetings are suspect. In most cases dam committee members seem to have reported how they are supposed to meet or how they used to meet during the construction of the dams but not what they are practicing at the moment, after the construction of the sand dams. This is so particularly with cases where some respondents reported that they meet once per month or they hold elections frequently. Our conclusion is that the committees do not meet often for in general there is low maintenance management demand. Since there is no tasking committee members also stay in office indefinitely.

In the base line area, 38% of the respondents from Mutomo Division asserted that their water sources committees stay in office for one year while 12% of respondents from the same division asserted that they hold elections after two years. Thirteen (13) per cent of the respondents reported that the duration in office of their water source committees is indefinite. In Yatta Division water source committees are very few only 7 % of those interviewed reported existence of water source committees. According to the respondents the duration in office is not fixed.

In the project area, it is evident that dam committees do not hold elections except in a few places. The functioning of the dams also seems to have ended with the construction of the dams. In the baseline, the water source committees likewise do not seem to replace/have any form of elections for the members. There is need to strengthen the committees for the maximum utilisation of the water, control of conflicts among users, control of quality and maintenance.

The results indicate that the dam committees are no longer functioning- there are no regular meetings or elections. However, cases of dam committee members calling for a meeting when there is a problem have been reported. A case in point was reported in Ngangani where a dam was in need of repair. When the members observed that the dam was leaking, they came together and raised money for the required cement for repair. This implies that it is not necessary for the committee members to have frequent meetings unless there is an issue to be tackled. Most community committees are issues oriented.

The non-functioning of the committees has a heavy implication on post –project issues like marketing; now relevant as new types of agricultural production are undertaken. It is the committees, which are presumed to evolve to higher levels of complex organisation e.g. organising marketing for the proceeds resulting from use of the water availed by the dams. There is a crisis at moment. The members are producing a lot of perishable horticultural products. SASOL recognises this post-project follow-up problem and internal discussions are afoot to decide whether the right institutional framework is to upgrade existing committees or to create others with specific tasking and specialisation.

Benefits Accruing to Dam Committee Members

In the bid to establish the benefits enjoyed by committee members, an open-ended question was posed requiring a listing of the benefits accruing to them by virtue of being office bearers. This question also sought to establish whether the dam committee members abused their positions.

Sixty four (64) per cent of the dam committee members from Kiindu catchment reported that they benefit from training, attending educational seminars where they gain knowledge and other related benefits. Sixteen (16%) per cent of the dam committee members said that they do not benefit than the other members in any special way from the project while 10% of them say that the community members respect them. Four (4%) per cent (8 out of the 50 respondents) asserted that they benefit by being accorded positions in other committees.

Dam committee members from Ithumula and Wii catchments echoed sentiments similar to those of their counter parts from Kiindu catchment on the benefits, which have accrued to them as a result of being dam committee leaders.

Dam committee members appreciate that the training they received from SASOL while implementing the project is beneficial to them in terms of gaining knowledge. It is also evident that the dam committee members do not benefit in any special way from the rest of the members. If such a thing is done, it bound to create a rift between the dam committee members and the rest of the members.

General Social Impact of Dam Committees

The impact of dam committees on age, religion, political party affiliation, wealth and gender were sought. The participants were asked their opinion on whether the dam committees had negative or positive impact on the community. Fifty one (51) per cent of the participants from the entire project area asserted that the committees had a positive impact in relation to composition by age. Twelve (12) per cent said the committees were not integrated well in terms of age while 37% said the committees had no impact on the same. The percentage responses for impact on religion, political party affiliation, wealth, and gender are as follows 51%, 51%, 53%, 55% and 51% respectively.

Kiindu catchment dam committee members reported that the committees have impacted positively on these social aspects with 68%, 76%, 72%, 74% and 82% rates for age, religion, political party affiliation, wealth and gender respectively.

Data from Ithumula catchment correlate with that from Kiindu catchment. The results are tilted towards positive impact. Gender integration led with the highest percentage score, 95 % followed by 87% for age. Wealth scored 80% while religion and political party affiliation tied with 77%.

Participants from Wii catchment, paint a different picture on the impact of dam committees in regard to all these aspects. They asserted that the dam committees have positive impact on these aspects. Seventy (70) per cent for religion, 80% asserted that the committees have a positive impact on integration across political party affiliation. Eighty (80) per cent said the dam committees have lead to more integration of community members in relation to wealth while 84% reported that the committees have a positive impact in relation to gender participation in community work.

There was no marked difference between the male-female segregated data. Seventy one (71) per cent of both males and females reported positive impact on the integration on wealth basis. On gender relations, 72% and 74% males and females respectively reported a positive impact, while 71% and 72% of males and females asserted that there was no friction between members subscribing to different political parties in the project area. The levels of integration between members of different religious groups were also highly positive. Seventy-two (72) per cent and 75% of males and females respectively said there was no discrimination on religious basis in the formation of dam committees. However, 41% of males complained about the structure composition compared to 22% females.

More than 66% of the participants from Kitungati (Kisasi) sub-location reported that the committees had impacted positively on the integration of the community in relation to age. Three (3) per cent said the committees had a negative impact and 21% said the committees had no impact. Similar figures hold for all the other aspects i.e. 66% for religion, 60% for political party affiliation, 62% for wealth and 68% for gender.

Review of the training material used by for training shows that initially SASOL was not sensitive to some of the aspects of committee composition like age and gender. Review of the training material used in the areas where the project was implemented latter show that all these aspects are put into considerations while forming the project dam committees. This explains the communities' satisfaction with the impact of the dam committees in relation to these aspects.

9.4 PROMOTING OR LIMITING COMMUNITY COOPERATION

When asked the factors, which promote community cooperation, the most mentioned factors are hard work, commitment, unity, peace and good leadership. Hard work, unity commitment and peace score high percentages among all the categories of respondents.

Table 9.4: Factors Promoting Community Cooperation Among The Participants

Factor	*Promoting*
Hardworking	15
Commitment	14
Listening to others problems	5
Peace	8
Good leadership	12

The factors which both participants see as obstacles to community cooperation are political party affiliation, gossip, lack of respect, poverty, diseases, hatred, poor leadership, illiteracy and /or ignorance and corruption. Ignorance and/illiteracy, poor leadership, poverty and corruption are mentioned as the major obstacles to community cooperation.

The same factors limiting and promoting development are similar (though with variations) in the project area and the baseline survey area.

Table 9.5: Factors Limiting Community Co-operation Among The Participants

Factor	*Limiting*
Political party affiliation	8
Gossip	8
Lack of respect	6
Poverty	13
Diseases	5
Poor leadership	21
Hatred	22
Illiterate	21
Corruption	14

In Yatta Division, 19% of the respondents reported hatred as one of the major obstacles to community development activities, 23% gossip, 12% corruption, and 19% Illiteracy 20% poverty while 5% said there are other factors limiting development.

In Mutomo Division, 15% claimed that hatred is an obstacle to development in their area, 13% gossip, 12% corruption, 31% Illiteracy, 41% Poverty, while 8% cited other obstacles.

Respondents from the two Divisions reported the following as the factors, which promote development in their areas: commitment (11%, Yatta; 12%, Mutomo), hard work (9%, Yatta; 8% Mutomo) and good leadership (12%, Yatta; 40%, Mutomo). The main factors that were identified in both the project area and the baseline are similar.

9.5 LEADERSHIP OPPORTUNITIES

Community leaders are replaced from time to time. As old leaders phase out, young leaders have to replace them. Consequently, the society should keep on training young leaders so that when there is need for replacement, they are well prepared to undertake the responsibility without problems. This is a key variable not commonly found in the literature about project sustainability.

Seventy-two (72) per cent of the participants reported that the community gives those who haven't led opportunities to do so. Twenty-eight (28%) percent said the community does not allow them to lead.

Eighty seven (87) per cent of the participants in Ithumula catchment asserted that their community give those members who had no opportunity to lead elsewhere a chance to do so. Thirteen (13%) per cent of them said that the community does not give those people a chance to lead.

Sixty-six (66) per cent of the interviewed households in Kiindu catchment said that they consider those who have never led for leadership opportunities. Thirty-four (34) per cent of them said that the community does not.

Data from Wii catchment indicate that 70% of the dam committee members asserted that the community gives opportunities to do so.

In Mutomo, 40% of the households said that the community puts people who haven't lead elsewhere into positions of leadership while 54% said that the community does not let them do so. Similar percentages were obtained from Yatta with 51% of respondents saying that the community considers people without leadership experience for leadership responsibilities while 44% of them asserting that the community does not.

The results point out that communities try to train people for leadership by giving them opportunities to lead in committee while working with the experienced people. In some areas its clear that its only people who have been leading who are trusted with leadership positions while in other areas, people without leadership experience are considered for leadership.

9.6 SPECIFIC BENEFITS ACCRUING FROM GROUP MEMBERSHIP

A part from benefiting from water made available by the construction of sand dams, participants from Wii catchment have benefited in several other ways. The major benefit recorded in Wii catchment was the increase in social interaction among community members. Thirty (32) per cent of those interviewed reported that community members are able to interact freely while working in the project. Thirty-six (36) per cent asserted that coming together to implement the project has led to formation of groups whose objective is to assist members in terracing, harvesting and other related activities. Availability of water has made growing of vegetables possible.

Participants in Wii catchment (24%) reported formation of community groups mostly dealing with planting of vegetables, and seedlings for commercial purposes. In the same area, women have formed merry go around groups *(Myethya)*. The group members contribute funds aimed at uplifting members' welfare. Sixteen (16) per cent of those interviewed reported membership in these new groups. By working together in the project, some members reported that they have acquired new friends, 12% of them reported having benefited in this way while 4% reported that during the period of working together, a forum presented itself for advising young people.

The implementation of the project in Kiindu catchment area has resulted in free interaction among members as reported by 26% of them. The same percentage reported formation of groups to help in terracing, harvesting and other related farm activities. Twenty one (21) per cent of the participants said that members have formed groups for planting vegetables and seedlings for sale while 19% have made new friends. Young people from Kiindu are benefiting from advice from older members of the society.

Ithumula catchment participants reported as follows; 25% said community members interact freely now, 12% asserted that community groups have embarked on planting of vegetables and seedlings, 14% have formed self-help groups which help members in undertaking harvesting terracing and other farm activities. Fourteen (14) per cent reported having acquired new friends while constructing the sand dam(s) while 8% of the participants reported that young people have benefited from the advice given by the older members of the community. Women members have formed welfare groups to contribute funds so as to improve their standards of living.

Analysis of dam committee members' data tells a story similar that of the project participants. In Kiindu catchment, 21% of the dam committee members reported that the implementation of the project has lead to formation of groups whose objective is to assist members with farm activities. Eighteen (18) percent reported increased interaction among community members while 15% said

that they have acquired new friends with 15% reporting formation of groups for planting vegetables and seedlings for sale. Five (5) per cent of the respondents asserted that old people are advising young people. Among the interviewed dam committee members from Ithumula catchment, 28% of them said that community members are able to interact freely and according to 13% of them; members have formed groups whose main function is to assist in farm activities. The other benefits recorded were; women groups for collecting funds (6%), advice of young people by the aged members of the community (4%) and making of new friends (2%)

The main activities reported for non-participants who are members of groups in their communities include; women groups for contributing funds, formation of groups assisting farm activities.

Baseline data from Yatta indicate that the majority (66%) of the respondents are members of community self-help groups. In Mutomo, 32% of the respondents claimed membership to self-help groups. Major activities, which are undertaken, by these groups of the two divisions are *Myethya* groups for assisting members in farm activities and contributing money to a common fund.

The above discussion shows that by coming together to implement a community project, community members benefit in several other ways. By coming together to implement the sand dam project, the process has set into motion a number of other activities as shown in the foregoing discussion. The benefits accruing to members go beyond the set project objectives. This implies that one community project can be utilised in tackling a number of community problems.

10.0 IMPACT OF COMMUNITY TRAINING

10.1 TRAINING CONTENT AND COMPOSITION OF TRAINEES

To teach people on how to make maximum use of the availed water and soil conservation to check dam siltation, the initiator of the project (SASOL) offered some training opportunities before the implementation of the project. The training sessions covered lessons on food budgeting (measuring family annual food requirements, keeping enough food for the household, cooking the right amount of food and selling what is considered a surplus at the right time), soil conservation (terracing, tree planting and making compost manure) and sanitation (digging toilets). The training was imparted on persons selected by the individual communities who were to build a dam. It is only natural that most of the trained ended up being dam committee members. Trainees were expected to train others but no systematic follow-up was made until 2002, when the sanitation training was structured in such a way that the SASOL trainees could monitor numbers of people subsequently trained. This was done after the completion of this report's fieldwork. SASOL Field Manager argues that there has "significant scaling up given the fact that communities decided on who was to be trained and the subsequent multiplier effects".

Nine trained individuals, selected at random from Ithumula/Maluma catchment were asked to state the number of people they had managed to share the training lessons with and the number that followed the advice. The results are tabulated in table 10.1 below.

Table 10.1: Training Scaling-Up Effect

Respondent	1	2	3	4	5	6	7	8	9
Number Taught by respondent	6	5	2	30	3	0	9	5	10
Number following the teachings	3	0	2	25	2	0	2	2	3
Percentage	50	0	100	83	67	0	22	40	30

A large number of the respondents advised that the training was appropriate for women because the courses centred on roles lying in the female gender domain like food budgeting. From Table 10.2, it is noted that the majority of the trained participants were men as shown. It is only in Kyangala and Syanduini village where the number of women either equalled or was greater than that of the their male counterparts.

SASOL has also done natural resource management and Project Management/Leadership training in the areas where the project has been implemented. The random data presented above is only partial. It may be a good ides to specifically commission a study of the content, methodology and impacts of training, as a separate study for survey data does not rest the issues.

10.2 MANAGEMENT OF WATER RESOURCES

Control of Water Sources to Avoid Negative Consequences

Asked the kind of plans they put in place to avoid negative consequences, the respondents gave a variety of responses. Some said that children are not allowed to play near the sand dams to avoid

cases of drowning; only participants have access to the water. Others said that grass is planted to avoid erosion of the banks. This method was reported mostly in Ithumula and Kisiio catchments. It was not reported in Kiindu catchment. In dams with wells, respondents said that the wells are covered with lids.

Table 10.2: Composition of Trainees By Sex

Village	Men	Women
Mathayoni	8	2
Utuneni	4	2
Mbiuni	5	2
Syanduini	4	4
Metika Mbuu	6	1
Kyangala	2	3
Kavuo	2	0

In the global participants' data, 31% said that control of the use to avoid negative consequences was practiced.

In Kiindu catchment for example, 84% of the participants reported that they looked at the issues before they embarked on the work of constructing the sand dams.

In Ithumula catchment, participant's opinion on the issue were somewhat different. Compared to Kiindu catchment, the percentage of those who reported that the issue is put into consideration, (54%), is surprisingly lower. Thirty-six (36) per cent said that the issue was not given consideration.

Participants gave similar responses from Wii catchment, 30% said planning is done to avoid the negative consequences while 70% said that it is not done.

Participants from Ithumula/Maluma sub-location (42%) said they thought through negative consequences of the sand dam whilst 53% said they did not.

In Kyangunga sub-location, the situation is similar, 43% of those interviewed asserted that the issue was considered while 57% said it was not.

Non-participants said that they don't have any plans to avoid negative consequences bound to result from their water sources because the water sources are natural.

It is clear from the results that before a sand dam is constructed, potential sources of negative consequences are given different weight in different areas.

Protection of Water Points

The global participants' data shows that 59 % of the respondents were not protecting their water sources before embarking on the project. However, after the project the number of participants protecting their water source was kicked up from 49% to 82%. This protection was limited to covering the wells with lids, and fencing the sand dams and scoop holes.

About 40% of the dam committee members Kiindu and Ithumula catchments said that they don't practice water source protection.

In Wii catchment dam committee members reported that the percentage of those who don't protect their water points declined from 36% to 16% after the project.

Dam committee members were trained on the importance of protecting water points from contamination. To test whether the training was effective, respondents were asked to report on the same. Before the project, only a small percentage of respondents used to protect their water sources from contamination. However, after the project it is observed that the tendency is reversing with slightly higher percentages adapting the practice. Water protection seems to be limited to fencing of the water sources and covering wells with a lid.

It was reported that after the project 57% compared to 48% of males before the project was now protecting their water points. The percentage of females protecting the water points was slightly high than that of their male counterparts. After the project 61% in relation to 55% of females before the project was taking care of their water resource. It is worth noting that males are more prone to polluting water sources because in most cases more men are known to bathing a few metres either up- or down-stream from the water collection point using polluting soaps compared to females. On the other hand it is women who take clothes to the rivers for washing. More often than not clothes are washed inside the river. Phosphates in the soap are a contaminant.

In Kyambiti (Mulango), 60% reported that they were protecting their water points. There was no difference between the situation before and after.

In Ngangani (Kisasi), 62% of the interviewed respondents reported that they were protecting their water source compared to 42% before the project.

In Kwa Muli (Katulani), 61% of the participants protect their water source by fencing, installing a gate and locking the gate.

These findings were compared with observations in the baseline survey and the degree of variations was reported to be very high. For example, in Syomunyu (Kanyangi), 91% of households were found to be using unprotected sources of water.

In Kituti (Athi location), 60% of the households do not to protect their water sources while fencing of water source was the major practice of protecting water sources among the households (69%) in Kathungu sub-location (Ikanga location).

In Yatta Division, the level of those fetching water from unprotected sources is quite high (60%) compared to 34% in Mutomo. The main method of protection in the two Divisions is fencing 27% and 43% for Yatta and Mutomo respectively. Covering with a lid is also used as a water

protection method as reported by 8% and 6% of the respondents from Yatta and Mutomo respectively. In Mutomo Division, 6% of the respondents reported that they employ a watchman to take care of the water source. This is particularly common in Mathima location.

Data shows that participants are now protecting their water points than before the project particularly during the dry season. During the wet season people use unprotected sources.

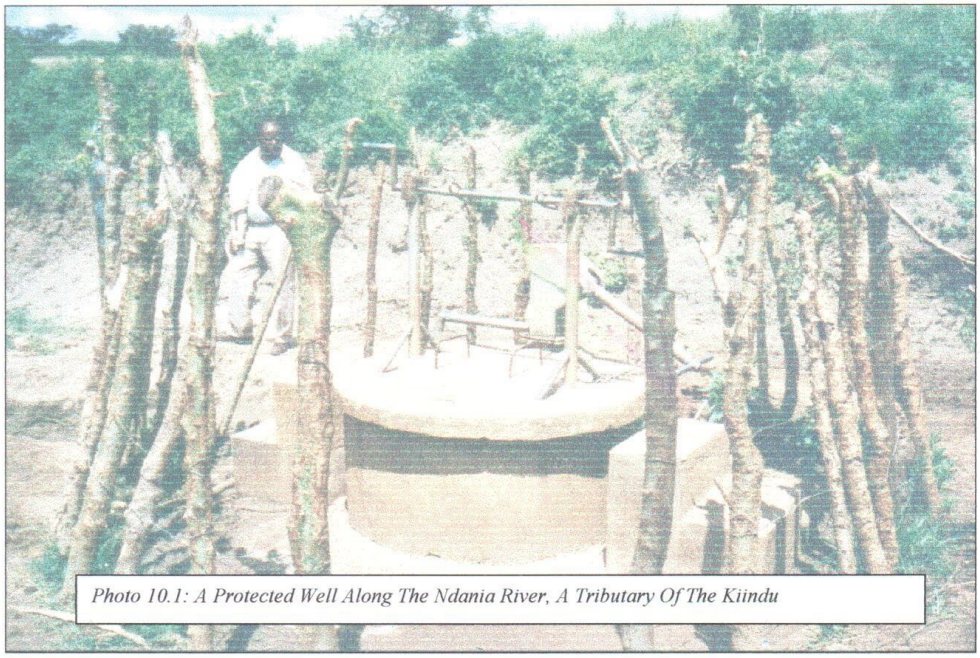


Photo 10.1: A Protected Well Along The Ndania River, A Tributary Of The Kiindu

Soil Conservation

Participants from the three catchments (Kiindu, Ithumula and Wii) reported that soil conservation activities have increased as a result of training they have received during the process of implementing the project and after. SASOL argues that the rationale for community training is to impart to members of the specific communities that the necessity of undertaking soil and water conservation activities and their relation to improving production. In general communities have taken up terracing, tree and grass planting as well as riverbank protection.

Gabion construction was reported in Ithumula catchment. Formation of *misonzo* seemed either to decline or not to change after the project. *Misonzo* formation was being substituted by terracing which is more permanent.

In Yatta Division, most of those interviewed have not made significant attempts to conserve their land. Forty six (46%) per cent reported that they have not planted any tree, 64% have used *Misonzo* as a method of soil conservation. 24% have no single terrace in their land while 32% reported that they do not plant grass as a method of soil conservation.

In Mutomo Division 43% of those interviewed have not planted any tree in their land, 27% do not use *misonzo* in their farms to conserve soil while 43% have not terraced their farms. The above findings imply that farms in Mutomo are subject to soil erosion. Casual observation supports the above findings. Exhausted farms are common. Charcoal burning and the historical factors discussed in section 2.2.2 accelerate soil erosion.

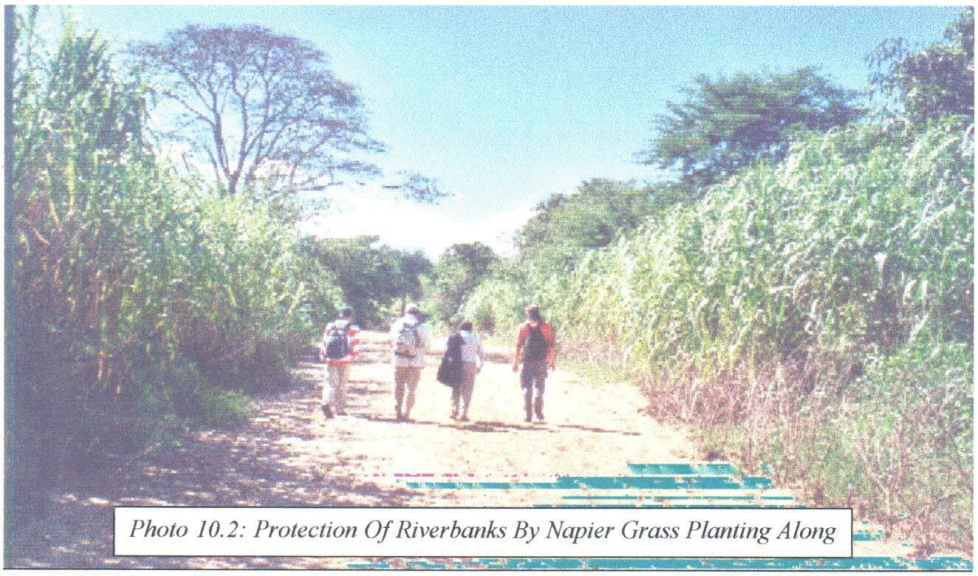


Photo 10.2: Protection Of Riverbanks By Napier Grass Planting Along

Community Pollution Penalties

To determine whether communities are in control of their water resources, participants were asked the forms of action the community would take in case any one was found polluting the water source. The data sheet enumerated the following sources of pollution: washing inside the dam/well, washing clothes inside the dam/well, watering animals in the well/the dam, spraying chemicals around the dam/well, defecating/urinating near the dam/the well and dropping objectives in the source.

On average, 50% of the participants (global data) reported that they would take action to polluting individuals.

The respondent was required to mention the type of punishment, which is passed to the offender. The penalties and severity were found to vary from place to place. In Ithumula catchment most of the participants (65%) opted to fine the offender and to warn or caution them.
There is a remarkable difference in actions to be taken between participants and non-participants. Most participants reported that they report the offenders to the provincial administration followed by paying fines, while non-participants said that they fine the offenders or caution/warn them.

In Kiindu catchment, it was found that only 21% of those interviewed would take an action against those found polluting water sources.

In Wii catchment, majority (37%) of those interviewed would fine those found polluting water sources and to a lesser extend report them to the water source committee or the provincial administration. Strictness in pollution control was also reported in Kivyuni (Mathima). Results show that on average 96% of the interviewees would resort to fines.

Warning/cautioning is the action 62% of respondents in Kanyonyo (Kwa Vonza) would take against water source polluters.

In Yatta division, the respondents seem to be less concerned with those found polluting water sources. Seventeen (17) per cent reported that they would fine the offender, 13% said that they would warn the offender, 1% would report the person to the provincial administration while the majority (56%) would not take action. In Mutomo division the residents are more concerned with protection of their water sources. Data show that 54% of those interviewed would fine the offenders, 3% would warn the offender. Three (3) per cent would report to the provincial administration while 40% asserted that they would take no action.

In the male-female disintegrated data, 20% of males reported that they would either fine or report the culprit to the provincial administration for appropriate action. Only a small percentage would warn (10%) or excommunicate (6%) such individuals from the water source. Among the females, 24% would fine polluters. Fifteen (15%) per cent would report to the provincial administration compared to 10% who preferred to warn or excommunicate the offenders.

The availability of water in the two areas explains the differences between the actions to be taken by the respondents. In areas where water is scarcer, the attachment to the source is more than in areas where the level of water scarcity is low.

10.3 OWNERSHIP OF AND ATTACHMENT TO WATER SOURCES

Ownership of Water Sources

Ownership of a water source by the community is very important as far as sustainability of water projects is concerned. In projects where the external collaborators fail to involve the local communities, make use of local knowledge and resources and ignore gauging the suitability of the technology, levels of sustainability are usually low. The enumerators were supposed to read out statements in regard to the ownership of the source, mentioning various stakeholders such as the Government, donors, schools, individuals, community, etc: For example, "The Government owns your water source". The respondents were required to state whether the statement was true or false and then explain their answer. It must be noted that the answers were not mutually exclusive.

From the global data, majority (77%) of the participants indicated that the community owned the sand dams. Some 44% reported that the initiator of the project, SASOL, owned the dams.

The sense of ownership of the water sources among the participants in Ithumula/Maluma, Wii and Kiindu catchments was found to be very high. Majority (over 90%), in the project areas stated that the community owns the source. The explanation advanced to support their claim was that the community took a leading role in the construction of the sand dams. The dams are sited

on community land *(Masyuko),* use of local materials (sand and stones), and local resources (labour).

In the female-male data, 69% of males compared to 82% of females reported that the members of the community owned the dams. Forty-nine (49) per cent of males in relation to 38% of the females said that SASOL owned the dams. Only 15% of both females and males asserted that the government owns the dams. This difference could be explained in terms of participation. Majority of females took part in the construction exercise hence could be in a position to tell who owns the dams in terms of the effort expended in the building process.

Table 10.3: Ownership of Water Sources- Global Data

Who owns the Dam	(%)
Community members	77
Government	18
Some individuals	5
Ruling Party (KANU)	5
Kathambi	5
SASOL	44
Schools	9
Main opposition in the region (SDP)	1
Christians	5

However, in some cases the respondents could not de-link the ownership of the water sources. In Kiindu catchment for example, the Government and SASOL were reported to own the water source.

Among the non-participants, in Ngungi (Nzambani), it was stated that the community own the source (88%) and further the Government (35%) own their sources of water.

In Uiini (Kasaala) it was reported by 85% of the respondents that the community own their water sources while 20% asserted that the Government owns sources. Water sources in Kamandio (Miambani) are absolutely (100%) owned by the community.

In general the baseline data show that the sense of ownership is tilted towards community ownership. The same applies for Mutomo.

Generally in Yatta Division, majority (83%) of those interviewed asserted that water sources are owned by communities, 4% by the government, 22% by individuals while 2% reported that the sources are owned by Kathambi.

Data collected from Mutomo division indicate that 79% of the respondents reported the sources as being owned by the community, 15% by the Government, 5% by individuals while 4% said that the sources are owned by *Kathambi* cult. Most respondents do not admit openly that that *Kathambi* cult women control the water sources. In-depth interviews show that those who believe *Kathambi* cult women control water sources are higher than easily reported in a formal interview to outsiders. All the community members both members and non-members of the cult have to

adhere by the user rules set by the cult leaders. Failure to play by cult rules leads to ex-communication from the community or a severe punishment of the persons in question (See 10.8 Water Within The Complex Kitui Social Base: *Kathambi*).

From the foregoing discussion, it has been established that majority of the respondents reported that the dams are owned by community members. Some fewer respondents cited SASOL as the owner of the dams. This could be attributed by the fact that SASOL supplied what the community considered to be the most important ingredients to the project, cement and reinforcement bars as well as masons and supervisors.

Attachment to Water Sources

Do the households value the investment they made in the sand dam project? Do they have any emotional attachment to the water source? Respondents were asked to give the kind of action they would take in case they found somebody demolishing their water source, both at individual and community level. Also, it must be noted that the more time an individual takes to act and the severity of the action could be interpreted to mean less attachment.

From the global data, 40% and 32% said that they would report to the dam committee chairperson and to the provincial administration respectively. Only 4% would use force to restrain the person. At community level, 36% would report to provincial administration or the police while 8% would report to SASOL. Those who would prefer to use force increases to 16% at the community level.

Different responses were derived from this question. In Kiindu catchment 32% of the respondents said that they would report to the provincial administration while 22% would report to the police. Only 16% reported they would use force to stop the person. At community level, 44% of the participants in Kiindu reported they would gang up and beat up the person. A similar percentage (44%) said that they would report to police/provincial administration.

In Ithumula catchment, 67% of the participants said that they would report to the police or the provincial administration. Only 5% would use force to stop the person. Some 10% of the members said that they would either report to the chairperson or to other members. At community level, 61% said that it would report to the police or the provincial administration while 10% and 15% would beat up the person and use force to stop him/her respectively.

Households from Wii catchment said that they would take the following actions as individuals; 8% said that they would establish the reason behind the demolition, 40% asserted that they would report to the provincial Administration, 8% said that they would summon the other members and take action, 32% said that they would report to the head man while 4% asserted that they would use force to stop the person from demolishing the dam. The same percentage (4%) would report the culprit to the police. At community level the action to be taken is a bit different; the largest number (32%) said that it would report to the provincial administration, while 20% said that they would take other actions. Twelve (12) per cent claimed that they would report to the provincial administration. Sixteen (16) per cent claimed that they would use force.

In Kyangunga sub-location, 42% of the participants would report to provincial administration or the police while 14% would just question the reason for the action. Nine (9) per cent would report to the dam committee chairpersons. Out of the participants, 7% reported that they would report to

SASOL. Only 3% said they would resort to use force. At community level the action shifts to reporting to provincial administration and police (51%), while 16% would report to dam committee chairpersons. Seven (7) per cent would beat up the person. Similar observations were made in Wii sub-location.

In Kwa Muli (Katulani), 42% of the respondents reported that they would report to provincial administration while 14% would report to the dam committee chairperson. Twenty-nine (29) per cent claimed that would resort to use of violence and force the culprit to bear the cost.

On the same issue (attachment to water sources) responses for from Yatta and Mutomo are as follows; 26% of the individuals would report to the provincial administration, 24% asserted that that they would force the person to stop while 50% said they wouldn't act. As a community, 29% of those interviewed claimed that they would report to the provincial administration, 25% said that they would force the person to stop, while 25% claimed they would report to the police. Forty-six (46) per cent said they could do nothing.

In Mutomo division, of those interviewed, as individuals 34% would report to the provincial administration, 5% claimed that they would force the person to stop. Thirteen (13) per cent said they would report the action to the police. Its only 7% who reported that they wouldn't take any action compared 50% who said so in Yatta division. As a community the respondents asserted that they would take the following actions; 44% reported that that they would report to the provincial administration, 16% claimed that the best action would be to force the person to stop while 10% would report the concerned person to the police. Those who said that as a community they wouldn't take any action were 14%.

It is interesting to note that almost all the participants thought of some action that they would take against polluters. The severity of the action varied across various participants and was somehow mild among the non-participants in the baseline and the project area.

Willingness to Accept Compensation (WTC) For Water Source

What values do households attach to their main sources of water? To answer this question, the households were asked the minimum amount of money they would be willing to accept as compensation for the loss of their main source of water. This question also endeavours to establish existence of alternative sources of water. Where the figure stated is low, it means there are other sources of water, not too far from the respondents.

In the participants global data 69% of the respondents could not accept such an act, leave alone gauging monetary compensation. The minority could only expect between zero and Ksh 10,000 as compensation for the loss of their water resource.

In Kiindu catchment, participants could not fix a premium on their water source. This is portrayed in the fact that 78% of the committee members said their source of water was so invaluable and thus could not accept any monetary compensation. They couldn't imagine staying without their source of water.

Data collected from Wii catchment show that 4% said they could accept Ksh 500. 16% could accept between Ksh 1,000 and 5,000. 8% fixed a premium of between Ksh 5000 and 10,000 while 4% said they could go for Ksh 10,000. To 60% of the dam committee members the idea is

unacceptable. They could not fix a value on their water source. The Ithumula case can be seen in the table below. They asserted its too dear too them.

The situation in Ithumula catchment is similar to that of Kiindu catchment. The level of attachment to the water sources is quite high as shown in table 12.6 above. This is not surprising owing to the high level at which the project members are utilising sand dam water for economic purposes.

In the male female separated data, only 30% males compared to 42% of females could not tolerate demolition of their water resource. This reflects the fact that the burden of water collection and dams construction lied with women, and thus could think about being compensated of their effort in the entire process. Thirty-three (33) per cent of males in relation to 30% of female would demand over Ksh 10,000 for the loss of their water source. The rest would ask for less than Ksh 10,000 for the same.

Table 10.4: Value Households Attach To Their Water Source

	Global data	Ithumula	Kiindu	Wii	Male	Female
500 ≥ Ksh.	3	0	4.0	4.0	2	6
500 < Ksh. ≤ 1,000	3	0	8.0	0	2	4
1,000 < Ksh. ≤ 5,000	6	1	0	16	18	5
5,000 < Ksh. ≤ 10,000	4	4	0	8	10	13
10,000 < Ksh.	5	10	0	4	33	30
Not acceptable (invaluable)	69	70	78	60	30	42
Not reported	10	15	10	8	5	0
Total	100	100	100	100	100	100

In Nzangathi, 34% of the respondents said that they would be willing to accept between Ksh. 1,000 and Ksh. 5,000.

In Kyangunga sub-location, 39% and of the participants would accept Ksh. 5,000 and below while 5% would not accept compensation.

Data from Yatta show that 10% of the respondents would accept less than Ksh. 500 as compensation for their water source. 7% would accept between Ksh 500 and 1,000, 9% between Ksh. 1,000-5,000. 3% a fixed a premium of between Ksh. 5,000 and 10,000 on water sources while 14% asserted that they would accept over Ksh. 100,000 as compensation for their water sources. To 26% of the respondents the action is unacceptable because their water sources are too dear to them.

In Mutomo division, the residents attach a higher value to their water sources compared to Yatta Division residents; (3%) asserted that they would go for Ksh. 500. 3% between Ksh 500 and 1, 000. 15% would accept between Ksh 1000 and 5000. 5% between Ksh 5000 and 10,000 while 46% reported that they cannot go for anything below Ksh. 100,000.

In Mbitini (Mbitini) and Mwala (Mutomo) 42% and 36% of the participants would accept Ksh. 10,000 and above.

The results from this section point to the fact that neither the males nor females in the project area could stand the sight of what they expended a lot of efforts being destroyed. They were satisfied with the project and could not imagine receiving compensation instead of continuing to reap the benefits accruing from the project.

10.4 DISEASE AND SANITATION MEASURES

Waterborne Diseases Mitigation Measures

Incidences of waterborne diseases are quite common in Kitui district. According to GOK and UNICEF (1992), the most common waterborne diseases in Kitui district are; malaria, bilharzias, skin diseases and eye infections in descending order. Respondents were asked: What precautionary measures do households take to protect themselves from water related diseases? Boiling of water is the most popular mitigation measure among the participants and non-participants in the three catchments from the global data. Although the percentage of boiling water appeared to be low before the project it increased to about 78% after the project.

The collected data show that 72%, 69% and 94% of participants in Wii, Ithumula and Kiindu catchments respectively boil drinking water.

Table 10.5: Waterborne Disease Mitigation Measures

Method of Mitigation	Participants- Global	Wii	Ithumula	Kiindu	Yatta	Mutomo
Boiling	78	72	69	94	75	69
Chemicals	4	4	3	4	0	4
Clear Bushes	4	0	3	10	0	6
Well cooked Food	0	0	0	0	0	1
Drying stagnant water	0	0	0	0	0	5
Inoculation	1	0	3	0	0	2

For example, in Kyambiti (Mulango) before the sand dam project 75% reported that they were taking mitigation measures. After the project, this figure was kicked-up to 86%. Similar results were obtained from Kyangunga (Mulango, Kiindu catchment) with percentages moving up from 61% to 67%. The most notable improvement was reported among the participants in Ngangani (Kisasi, Mwiiwe catchment). The mitigation level rose 6% to 62% after the project. In Mbitini (Mbitini location, Kisiio catchment), mitigation levels remained the same before and after the implementation of the project (70%). This was limited to boiling of drinking water.

This data could be, to some extent, attributed to the training imparted to the dam committee members; its spill over effects on the other members of the community and the general training of all construction site participants on faecal-oral route and the necessity of blocking all contamination routes at the dam site during construction. A small percentage reported treatment of water using chemicals.

Other measures reported, though limited and not common in all the three catchments, included: clearing bushes around the compound, draining stagnant waters and use of mosquito nets. Minimal cases of treatment of water using chemicals were reported in some sub-locations. For example, in Kathungu (Ikanga), a baseline area, 20% of the respondents claimed that they apply this method.

In Yatta Division, 75% reported boiling of drinking water while in Mutomo 69% of the respondents reported that they use mitigation methods as shown in the table above. Unlike in Yatta, respondents in Mutomo reported application of various methods of mitigation. Water boiling remains the most applied method in all the areas.

In a nutshell, it is important to note that majority of the household know dangers posed by drinking unsafe water. However, waterborne diseases mitigation measures are limited to water boiling.

Sanitation

The cleanliness of water depends of many factors. Disposal of human waste is one of the factors affecting quality of water. If care is not taken, it impacts negatively on health. A question was posed to establish whether respondents have toilets and if they have whether they actually make use of them. Data enumerators were required to make observations on the same and record their observations.

Global data indicate that 72% of the households in the project area have toilets in their homes.

Results from Kiindu catchment show that 90% of the participants have toilets while 69% of their counterparts from Ithumula catchment have the same. In Wii catchment, 80% of the respondents have toilets facilities in their homes.

Seventy three (73) per cent and 72% of male and female-headed households have toilets in their households.

Participants from Kyangunga and Ithumula/Maluma sub-locations 72% and 66% respectively have toilets. Sixty-two (62 %) per cent of the participants from Kyambiti have toilets while the rest (38%) do not have. In Mbitini sub-location the results indicate that most households do not have toilets. It is only (47%) of interviewed households, which have toilets.

Baseline data from Syomunyu (Kanyangi) show that out of the interviewed respondents 64% of them have no toilets, worse still, in Kathungu (70%) and Kiangwa (77%) both in Ikanga location. A similar situation was reported in Kituti (62%) and Ndakani (80%).

The above statistics indicate that use of toilets is very low in some parts of Kitui district-especially in the Baseline areas. It appears as if toilet use is comparatively high in deforested areas. Studies carried in Zimbabwe show that during the wet season, human waste and other pollutants, which are washed into unprotected water points, increases bacteriological load in these water sources (Morgan, 1998). Ideally all households should have toilets. During 2002, SASOL is completing a Health and Sanitation Training Programme in the project areas. No doubt this will be evaluated in due course.

10.5 OPERATION AND MAINTENANCE OF THE DAMS

In making the choice of water resource supply technology, for sustainability, development partners are advised to select those technologies, which match local needs and are easy to be operated and maintained by the local communities (IRC, 1999) Some development partners are known to apply either 'elite' or 'cut and paste' technologies disregarding the local needs and relevance. Such projects collapse immediately after collaborators pull out (IRC, 1999).

To gauge the relevance of the sand dam technology to the community needs, questions regarding the responsibility of operation and maintenance (O&M), sources of funds for O&M and contributions by the community members, if applicable were included in the questionnaire.

In the global participants' data, it was established that over 50% of the respondents asserted that the dam committee members are supposed to maintain the sand dams. Thirty-three (33) per cent said it was the community, which was responsible. A small percentage (less than 10%) associated maintenance with the provincial administration.

In Kiindu and Ithumula catchments 18% and 28% of respondents respectively, reported that the committee members are responsible for operation and maintenance. The community was also mentioned. Sixteen (16) per cent of the dam committee members in Kiindu catchment asserted that the community is responsible for the operation and maintenance.

In Wii catchment, 56% and 28% of the interviewees reported that the dam committee members and the community members respectively are responsible for maintenance of sand dams and associated wells. The other party, which was reported to be responsible for operation and maintenance, was the dam committee chairpersons

Where do funds for operation and maintenance came from? Among the participants, in Kyangunga and Ithumula/Maluma sub-locations, the bulk of the funds for operation maintenance are sourced from the dam committee members as stated by 58% and 74% respectively. The dam committee members get money from their private sources!

Over 65% of all the respondents reported that no funds were needed in maintenance of the sand dams. The minority households that reported to have contributed towards maintenance-cited contributions ranging between Ksh 25 and 100 when need arises. This indicates the appropriateness of the sand dam technology in relation to low maintenance costs, the local incomes and expertise.

In Yatta Division (Baseline), 44% of those interviewed reported that they do not need any funds to maintain their water sources while 9% reported that the funds came from the community while 3% said that the funds are sourced from the politicians. Similarly, 59% of respondents in Mutomo reported that no monetary resources were needed for operation and maintenance of their water points.

Participants were torn by indecision concerning the sources of funds for operation and maintenance. Some cited that the dam committee members were responsible while others mentioned community members. But the most important conclusion is that sand dams require minimal operations and maintenance resources.

10.6 LAID DOWN CONDITIONS FOR NEW USERS

Dam members have conditions for non-members who want to join the project after the construction of the structures. According to the data, the conditions for joining vary from stated amounts of money to payments in kind.

In the global data, 22% of the participants reported that new users are charged between Kshs 200 and 500 while 21% said that the amount is not fixed.

Data from Ithumula catchment show that non-members pay Ksh. 100 while joining the project as reported by 5% of the respondents. Thirty-one (31) per cent asserted that the amount ranges between Ksh. 100 and 200, while 33% said that non-members pay between Ksh. 200 and 500 as a condition of joining using the water. Five (5) per cent stated that the figure ranges between Ksh. 500 and 1,000 while 8% claimed that the figure is not fixed.

Table 10.6: Laid Down Conditions For New Users

	Participants (Global)	*Ithumula*	*Kiindu*	*Wii*
Below 100	2	5	0	0
100-200	16	31	12	4
201-500	22	33	22	12
501-1000	9	5	14	8
Not fixed	21	8	20	36

Participants from Kiindu catchment stated the following figures as the amounts non-members pay as a condition for joining the project while 12% said that the amounts ranges between Ksh. 100 and 200. Twenty-two (22) per cent said they would pay Ksh. 200 and 500, while 14% between Ksh. 500 and 1000, 16% asserted that the amount is more that Ksh. 1,000 while 20% claimed that the amount is not fixed.

Data from Wii show the following, 0% below Ksh. 100, 4% between Ksh. 100 and Ksh. 200, 12% between Ksh. 200 and Ksh. 500, 8% between Ksh. 500 and Ksh. 1,000 while 36% stated that the amount is not fixed.

On the hand, the findings show that it is not money alone which non-members members have to pay to be allowed to use the sand dams, traditional methods are applied. According to 10% of the dam committee members from Ithumula catchment, non-members are required to provide a sheep or a goat as condition of joining the project. In Kiindu catchment, 2% of the members reported that non-members have to pay a goat.

It is evident that there is no uniform condition of joining the project. The conditions are area specific. What non-members have to pay to join the project is also within reach for those joining the project.

10.7 SCALING-UP AND COMMUNITY DEVELOPMENT

Linkage Between Dam Committees and Other Committee

In order to establish whether there is scaling up impact, in terms of social integration, respondents were asked whether there was any linkage between dam committees and other committees in the community. This question was aimed at establishing whether dam committees are linking up with school, church, cattle dip, funeral, infrastructure and other committees in the community. One of the objectives of the training of dam committee members was to use them as breeding grounds for leaders not only in the dams but also for other community projects.

Sixty eight (68) per cent of the participants from Kiindu catchment asserted that there are linkages between dam committees and other committees in the community while only 31% of the participants from Ithumula catchment reported linkage between dam committees and other committees in the community.

According to 27% of the interviewed participants from Wii catchment, there are linkages between dam committees and other committees in the community. Sixty-four (64) per cent of the participants from the same area reported that there are no linkages between their dam committees and other committees in the community.

In Kyangunga sub-location, 21% of the interviewed members said that their dam committees' link with other committees with 59% reporting that there is not any kind of integration between dam committees and other committees.

More males (35%) participants reported that there were strong links between the dam committees and other community committees compared to female (30%) participants.

There seems to be more awareness among dam committee members (concerning integration of committees) than it is among the dam members. This may result from the fact that the dam committee members may be invited to participate in other committees without the consent of the dam members thus limiting members awareness about the relationship between the dam committees and other committees in the rest of the community.

Nature of Linkage Among Community Committees

To capture the nature of the linkage, the respondents who had asserted that there was linkage between dam committees where asked to explain the nature of the reported linkage. This was an open-ended question and the interviewer was not supposed to guide or prompt the interviewee. Diverse responses were recorded as a result of this.

Thirty six (36) per cent of the dam committee members from Kiindu catchment reported that their opinions are sought in relation to the general development issues in their area, 20% reported that they are considered for other committees while 8% said committee members from other community committees are considered for leadership positions in dam committees.

Information collected from Ithumula catchment dam committee members are slightly different from those of Kiindu catchment since linkage is bent towards involvement of dam committee members in other committees or involvement members of other community members in the dam

committees. The two account for 28% of the involvement. Five (5) per cent reported that their opinions are sought concerning developmental issues are being discussed in the community.

Thirteen (13) per cent of the project members who reported linkages between dam committees and other committees from Ithumula/Maluma sub-location reported that the dam committee members' opinions are sought in relation to development issues. Five (5) per cent said that the dam committee members are considered for other committees in the community while the same percentage of respondents reported tapping of leaders from other community committees to lead in the dam committees.

Results from Wii catchment show that the highest kind of integration between committees is reported in the area of the community tapping the leadership from dam committees. Twenty-four (24) per cent of the interviewees asserted that members of their dam committees have found their way into other community committees. The other kind of integration reported from Wii is that of involvement of community committee members in the dam committees.

In Kyangunga sub-location, 16% of those who reported linkages in committees said that other community committee members are considered for leadership positions in the dam committees. Seven (7) per cent of the respondents asserted that their committee members have been given leadership chances in other committees in the community.

The linkages between the dam committees' and other committees in the project area seem to be moderate. Dam committee members opinions are sought when important community development decisions are being made. Further, dam committee members have been incorporated into other committees in community.

Influence of Project Trainees on Community Development Agenda

While implementing any project, it is important to factor in community information. Involving community members in project formulation, design and implementation stimulates their interest. This also guarantees participation and increases the sense of ownership among the project members. This ensures that the project members are able to continue with the project on their own after a development partner pulls out.

The study wanted to establish whether the project's training empowered those trained to influence general development activities taking place in their areas.

Data from Kiindu catchment dam committee members show that the community is able discuss and influence the development process in the area. Seventy-eight (78) per cent of the members claimed that they influence the developmental activities affecting their area. Only 16% said that they don't influence development activities taking place in their area.

The situation is quite different in Ithumula catchment; 33% of the dam committee members reported that they influence development agenda. Compared to Kiindu catchment, the results are amazing. This can be explained by the perceived individualistic behaviour amplified by Ithumula residents. It was reported that during construction work it was impossible to mobilise the people. Even though the people are hard working, they prefer to work individually.

In Wii catchment, dam committee members results are similar to Kiindu catchment; 68% of the dam committee members asserted that they influence development agenda in their area while 20% say that they don't.

In Kyambiti (Mulango location) and Mbitini sub-locations (Mbitini location) it was established that 58% of the participants asserted that they have influence over development projects taking place in their community.

In Ngangani (Kisasi location) 60% of the interviewed participants reported that the community has a say in projects. In Kwa Muli (Katulani), 95% of the participants reported that the community has influence over their development project. The respondents gave diverse ways in which their communities influence development activities in their area.

Asked how they influence development agenda the responses were as follows; dam committee members from Kiindu catchment gave responses distributed as follows; 12% said that chairpersons of groups, headmen and other leaders are requested to prepare forums so that their members can air their grievances concerning the issues at hand. Twenty (27) per cent of the interviewees reported that they influence development agenda in their areas through giving their views during barazas. Eight (8) per cent reported that they hold consultations with the concerned agencies before any project is implemented.

Data collected from the dam committee members in Ithumula catchment has the same pattern of distribution; the highest score (28%) was registered from those who said that the community influences its development agenda through barazas organized whereby members express their views when a project is being discussed. Interviewees who reported that chairpersons of groups, headmen and other leaders are consulted to gather groups for the purpose of expressing their ideas in relation to the project in question followed.

Data from Ithumula/Maluma sub-location participants is in line with that collected from dam committee members. Among those who said that the community influences development agenda, the 18% participants said that chairpersons of groups, headmen and other leaders are consulted to form groups for collection of members' opinions.

Participants from Wii sub-location asserted that they influence their development agenda through the following ways; the highest score (68%) was recorded from those who influence development through meetings, which are organised for community members to express their views. The rest of the data is similar to that of Ithumula/Maluma area. Participants from Kyangunga expressed views similar to those of Wii.

In Kituti (Ikutha) and Ndakani (Ndakani), 54% and 44% respectively of the interviewees reported that the community had some influence over the development projects taking place in their respective sub-locations while in Kathungu, 62% asserted the same.

The involvement of people in the development process seems to be area specific. The data doesn't have a specific pattern, in some areas the level of involvement is high while in other areas its low.

In Yatta division, 82% of the respondents asserted that they influence development they have a say in determining what goes on in the community in relation to development. Compared to Yatta

division data, the situation in Mutomo is quite different, only 44% of the respondents reported that they influence their communities' development agenda.

The above discussion points that the training done for dam committee members has benefited the community in the project area in a number of ways: one, it has assisted the community to identify community leaders, the trained leaders are now able to participate influencing the development agenda in their communities. This data points out clearly that there is a relationship, which is developing between dam committees and other community committees in the project area. The seeking of the opinion of the dam committee members indicates that the communities have been impressed by the performance of the dam committees. Like wise, the giving of leadership positions to dam committee members in other community committees points to the same. On the other hand, the tapping of leaders from other committees into the dam committees shows that the communities recognize the importance of involving these leaders in the success of the project. It is a logical conclusion then that there is a symbiotic relationship between the dam committees and other committees in the community.

The leadership experience gained by the members of the dam committees is benefiting other community projects and vice versa. It is also logical to conclude that the confidence which the community has on members of dam committees results from the fact that they assisted the community solve of the highest priority community development problem.

10.8 WATER WITHIN THE COMPLEX KITUI SOCIAL BASE: *KATHAMBI*

Water Is In The Female Domain

In general Southern and South-eastern Kitui has very limited water resources. In historic times this area was seen as *Weu-* i.e. grazing land. However, over the past hundred years, population growth in the area, in Kitui and Machakos district in general, has led to many more people having to earn their living in the area. Historical demographic data is not systematically available to allow researchers to document in detail how many people were in the larger Mutomo division before the census data of the sixties. By interviewing many community groups and administrators and reviewing some archival data, we have been able to establish some key conceptual and operational benchmarks in terms of population and water relations over time.

First major point about the relations of water and population is the fact that its scarcity since historic times led to the dominance of the *Kathambi* cult. Prof. G. Akong'a in Drought, Famine and Policy (Department of Sociology, University of Nairobi: February 1985 discusses the importance of *Kathambi* from a rain cult point of view. In Culture and Soil Erosion in Ukambani: the Colonial Factor in the Disintegration of African Culture and Environment, 1895-1995 (Oxford, Ohio: MA Thesis, Department of History, Miami University) J. M. Kitunda shows *Kathambi's* import in the development of resistance to colonial society. *Kathambi* is the Supreme Kamba Female Goddess. Field interviews suggest that she has, through her female mediums and women, total power over all matters related to water at all times and over food management during disaster periods.

Up to Kenya's independence, *Kathambi* rituals were strong with relation to water sources across the whole of Kitui district but more so in the south. Nobody was allowed to bring any metals into the streams or springs for to do so is to contaminate the arena of *Kathambi. Kathambi* women leadership enforced this. Metal is in the realm of the male arena and is related to fire, which is

the opposite of water in many African cultures. Metal is not just in the male sector but also in its ostracised sub sector of smithing.

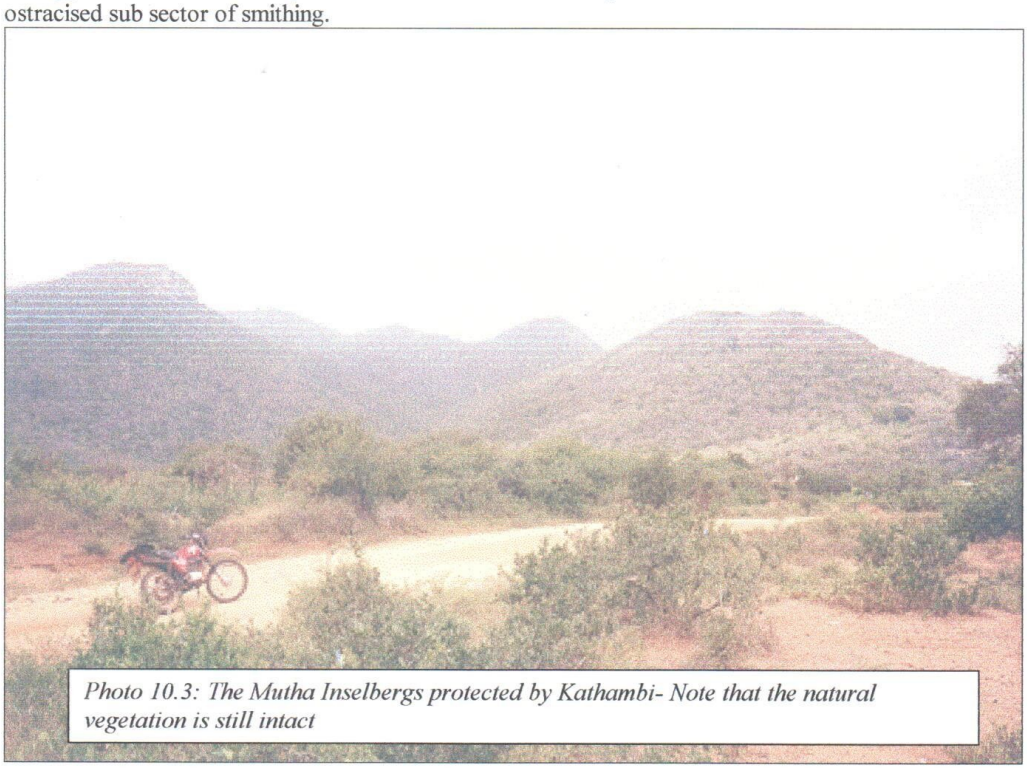


Photo 10.3: The Mutha Inselbergs protected by Kathambi- Note that the natural vegetation is still intact

Marriage Between Tradition And Modernity

Men never have any role in *Kathambi* worship rituals or any ritual activity directed by the women followers. If a man is needed to do something related to a *Kathambi* function, he is transformed into a woman for that express activity. We saw this practically when we sought to interview women leaders in Mathima. The born again fundamentalist Christian church preacher, who was part of our escort, had to be womanised so as to facilitate discussion and to be bound so as not to discuss their secrets. He was given a female name and the rank of an askari! The poor soul was trembling like a leaf during a storm throughout the interview!

Kathambi related control over water sources led to the total protection of Mutha hill and a few other inselbergs, during centuries past, for it was a place of survival even during the worst droughts. This massive hill, jutting out of the flatlands, enabled local populations to survive even the worst droughts for food, mainly millet and sorghum, could be grown in the hill at the worst times. Also significant was the availability of water in the hill springs to support livestock in the worst years. District Commissioner Kelly, who built more water structures in Kitui district than any other person, convinced the Kitui County Council to create a protected forest on the hill, in the late fifties. It is significant though that planting of exotic trees – found in all the other Kitui hills- e.g. Endau, Makongo and Mutitu in Eastern Kitui, Mumoni in Kitui North (now Mwingi) and Central Kitui Ranges, never took place on Mutha. The *Kathambi* women refused. Any

persons sent to plant did not dare fight the women who not only threatened to curse them but got snakes and bees to attack those foolish enough to climb the hills to begin preparations for planting trees! To date, anybody constructing water projects on the hill must get permission from the women. The same is true in a few other inselbergs in the south. Those who need to use the hills for collecting building wood and other forest products must also get permission form the women.

Water issues became more problematic, than when confined to the usual rainfall variations, after the populations of Kitui South lost their extensive grazing and survival cultivation lands which were in the area zoned as East Tsavo Park in 1947. Whilst the grazing land was generally used all year round, the marshes were mainly used as a reserve grazing land for the really bad droughts. Marshes were also used as food reserve production areas particularly when the usually common multi-season droughts disasters hit. These marshes are created as the Tiva River; the main river draining the district goes underground. This area is locally called *Ndia Ndaasa* i.e. the Long Dam. The park also blocked the utilization of the perennial Ganzi springs by the population. The gazetting of East Tsavo Park also meant that about 50% of the population of the period had do collapse back to the remaining area. Their animals had to move out of the park. The people and livestock put a lot of ecological pressure on the Southern Kitui land resource and it has never recovered to date.

The loss of Tsavo land and the two significant sources of water sources strengthened the power of the Kathambi women followers in the fifties as they adopted very stringent measures over the utilization of water sources in the remaining areas of Southern Kitui. Many informants in the area and the rest of the district tell the story of their accumulation of massive power to enable them to fine Chief Nzuki, arguably the most powerful colonial chief in Kitui. They were also able to encroach on the Christian families who had ignored them in the previous fifty years. Christian families needed to get water in sources controlled by the *Kathambi* women as supply areas shrunk driven by the reduction in available land resource and the inability of the ecology to regenerate as population and livestock pressure eroded the natural resources. The *Kathambi* women, who were definitely not sympathetic to the Christian way of life and the attendant favours granted to Christians by the colonial regime, dictated terms of how Christian women were to be incorporated into the Kathambi water control rituals. The control process, now applicable to everyone, is still intact another fifty years later.

In Kenya: Politics, Policy and Society (Nairobi: EALB, 1976), Prof. G. C. M. Mutiso discusses how colonial Christianity and attendant education created status inversion in the country especially in the rural areas. Those allied with the new beliefs and lifestyles, driven by Christianity and education, became the new powerful in local and national power configurations for the basis of power shifted. What is interesting in the case of the *Kathambi* women is the fact that local circumstances- loss of land and shortage of water resource- enabled them to not only survive but to become the dominant development control institution. This was achieved by their inversion of the water rituals and takeover of other traditional institutions.

Cults and Control of Natural Resources

There have been many studies of what are called earth, rain or territorial cults across the continent. In River of Blood (Madison: University of Wisconsin Press, 1992), Prof. J. Matthew Schoffeleers, who studied the evolution of the Mbona cult in Malawi, over several centuries, evaluates the import of these organisations and points out that they should be evaluated as territorial cults for "...they are

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centrally concerned with the political life of a specific land area and since their constituency is a group identified by common occupation of and rights in that land area"(p.7). The main concern of territorial cults is intermediation between social differentiation and the inequity it leads to. Intermediation is achieved by ritual inversion. He writes: "Ritual inversion is a source of hope, because it signals that things are not what they seem to be and there is power that can turn negative experience to positive...The outside, threatening, cruel or unexpected situation or element can be incorporated into a world view if it can be made to contrast complementarily with the inside, secure, old, and routine areas of existence" (p. 148).

We would like to suggest that this has happened to the *Kathambi* rituals. Historical data is not yet available to enable us to sketch the actual origins of the *Kathambi* cult but at the level of theory, it probably is found at the nexus of matriarch and patriarchy competition. Whatever the origin, the cult was denigrated during the colonial interlude as statuses were inverted. As Christianity and its rewards expanded, in the wider Kamba society, the *Kathambi* cult remained strong in the ecologically, and by extension socio-politically marginal Kamba lands. Southern Kitui is part of the really marginal Kamba lands. When this area was confronted with the reduction in grazing areas, the deterioration of the land driven by the loss of survival farmland and grazing to the park, *Kathambi* rituals had to address the needs of a society in crisis. Rather than remain only women issue oriented and only claiming traditional women followers, the old *Kathambi* rituals were transformed to embrace all women, Christian and non-Christian. Men were included since there were processes evolved for womanising them. That is not all. Whereas the traditional ritual concerns were in the water and food sector, the new concerns embraced the whole gamut of community development.

In the fifties, sixties and seventies, the *Kathambi* rituals emphasised support to family mutual help (*Mwethya*) to improve farm structures and other family based production processes like planting and cultivation. Since the eighties, the women argue, it has become clear that development of the community is accelerated by creation of public and not family (private) goods. Hence the *Kathambi* emphasis on wells, roads, schools etc.

Further, the new *Kathambi* leadership has taken the control attributes of the most supreme of the Kamba traditional institutions- the Ngolano -to enforce compliance in the collective development of the public goods as well as to enforce morality in the community. During the pre-colonial period, if an individual deviant or an issue threatened society, all the people met and made binding decisions on the particular individual or created solutions to the problem. *Ngolano* in this sense was the ultimate socio-political control and mobilisation institution embracing all women and men in a particular community assembled. The calling of *Ngolano* was by the male and female leaders of a village. This function is now found exclusively with the *Kathambi* women of Southern Kitui but is stronger in the area between Mutomo, Mutha and Kanziku currently

Consequently then, in Southern Kitui, the women do not just control water as is expected of *Kathambi*, the Goddess. *Kathambi* women have final authority not just on water construction and management issues but also on all construction and management of structures deemed important for the overall development of the community. They continue the originally *Kathambi* initiated process of protecting Mutha and Nzaini hills and other inselbergs as sources of water and other natural resources. They are the controllers of how and where water structures are to be built. They have, over the past twenty years, blocked the building of some water sources when the development agencies, bilaterals and ngos, did not consult. In Mathima location, they have been involved in the mobilisation of as varied development activities as construction of local roads, primary schools and lately of a community secondary school. Their power can be illustrated by several cases.

Control of Community Development Activities

First, the Mathima community decided it wanted to build a road. Every body was expected to contribute labour. One primary school headmaster argued that his wife was not a labourer and thus could not go to dig the road. He was employed and thus could not leave his work to go and do community work. The women met and decided to punish him for his social deviance. He and his family were sentenced to stay inside their compound and not to use any road since all the roads had been built by local people and he and his family had not contributed to that public good. That was not all. Nobody in the community was to give him any assistance or even talk to him. He and his family were confined to the home totally. Some may ask, how come he and his family did not just leave the homestead and just walk. They were prevented form exiting their homestead by magic and ritual. He ultimately had to make peace with the women. His road labour contribution was monetised and doubled. After payment, a chastised headmaster returned to the school but has not been the previous arrogant self. His children returned to the local school and the family resumed inter-actions with the neighbours.

The second case again is a local primary school head master that had refused to contribute to brick making for a local primary school. His very young children being sent to a school more than twenty kilometres away punished him. Of course they could not cope for they claimed to see ghosts on the way over and above the rigours of the walk. He had to negotiate with the women for a compromise.

The third example is that of chiefs' interaction with *Kathambi* leaders. Above we mentioned that in the past *Kathambi* women had punished Chief Nzuki who was possibly the most dictatorial chief in colonial Kitui. The details are that when the East Tsavo Park was created, people were supposed to only be moved to outside the park. Chief Nzuki, in his selfish wisdom, pushed the people all the way back to the Kanziku hills and privatised the beautiful grazing land, including water sources, between the hills and the park. This was to be his private family land. It is not that Chief Nzuki was greedier than his contemporary chiefs. Other chiefs did this in Kitui or Kiambu, for example, as the histories of Nzalai, Mwakini, Yatta, Kari etc attest. But in the Chief Nzuki privatisation, he controlled some Kathambi ritual spring sites at the bottom of the hills. These springs appeared only during extreme droughts, according to local informants. The women went to him and asked for a permit to sanction somebody. Since colonial administration was more systematic than is the case now, he had to write a letter authorising them to sanction an individual. As soon as he gave them the letter, they arrested him for deviant behaviour! They took him to their meeting place and detained him until he paid the fine –his best bull- for blocking access to the water. He accepted that other people would use the springs.

Chief Nzuki, long since dead, is not the only chief the *Kathambi* women dominated *Ngolano* have exercised power over. This year (2001) one local community decided to build a secondary school. Since the local community had to make the bricks, provide labour and bring water and sand as well as feed the masons, some community people did not attend regularly. The local chief asked the women to camp on the ground to ensure that those who are supposed to contribute bricks, labour, water etc for its construction do so expeditiously. What is interesting in this case is the fact that the women are now being used by provincial administration to compel compliance in a community activity, which is really in the public good arena. The Chief has less power on this than the *Kathambi* women.

Further, when we were collecting data in the field, the *Kathambi* women had called a meeting of one village and the local chief had called another the same day at a different site. All the people in the village went to the *Kathambi* women meeting. They then asked for permission to go to the Chief's meeting after having finished part of the agenda deemed more urgent than the Chief's by the Kathambi women.

It is important to conclude this discussion with an example of *Kathambi* women sanctions to deviant social behaviour. In the past fifty years a group of men had a habit of repeatedly raping women at a forested place called Mwanyani. One the individual in this gang was believed to be interested in sex with young primary school girls. Women caught him at a beer-drinking place. He was brutalised by Kathambi women to the extent that he currently does not have front teeth. He was banned from the community and now lives in a forest reserve demented. He survives by looting honey from people's beehives. When he sees or hears a female voice, he crashes into the thorny acacia running away from their presence.

The existence of *Kathambi* dominated *Ngolano,* the former being the structure of organising and the latter the process of control, is a challenge to the existent models about social control and development structures and processes in rural Kamba society, and other rural societies across this continent. Further, the limited data are also a challenge to the varieties of feminist theories, which see Kenyan rural women as totally male dominated throughout history. Beyond this, perhaps its most significant relevance is to critique a development theory, whose current version is privatisation, which is internationally sourced and practiced through weak state policies. This is more so if one wants to think about developing water sources for human consumption and improved production in the dry districts. If this is the operational consideration, there is need to see the women in a much wider setting.

Towards Relevant Development Perspectives

At a wide meta-theoretical level, the issue of understanding the role of *Kathambi* women in the affairs of Kitui may be a challenge to our understanding of the relationship of African patriarchy and matriarchy roles in a specific society over the centuries. This would facilitate our reinventing our history in general and the history of Kitui in particular. In *Reinventing Africa* (New York: ZED Books, 1997) Ifi Amadiume writes: "Patriarchy and matriarchy are social and political ideologies which directly decide the role and status of women in society; how society is to be organised; and how social subjects are to relate to one another. They are also ideologies, which directly decide the degree of violence and abuse of human rights that is permissible in society. Matriarchy as was constructed by African women, had a very clear message about social and economic justice. It was couched in a very powerful goddess-based religion, a strong ideology of motherhood and a general moral principle of love.

This is not the case with patriarchy, which seeks to control and rule women-indeed everyone. It always seeks to appropriate people's rights to self-determination and to bring everyone under the rule of the male. It has a basic masculinist ideology, which celebrates violence, valour, conquest and power in varying degrees. It is usually imperialistic. However, this patriarchal masculinist imperialism takes different characteristics under different political economies, or under different social systems. (p. 101).

In Kenya, the current water policy document states that water structures will be privatised to local communities. Policy statements have not yet disaggregated who in the community and how, other

than talking about water associations and their being "federated" into river basin associations. In the less traditional areas we are beginning to get local elites privatising boreholes or pumping schemes. This is seen as good in the global theoretical framework (or should one say in the meta-theoretical framework) singing praises to privatisation. Does the *Kathambi/Ngolano* type institution offer a more meaningful alternative where there is no water?

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 CONCLUSION

The success of the sand dam project in Kitui is based on community participation, which is strongly rooted in understanding of the differences and overlaps between male and female roles and responsibilities. The fact that almost all women involved in the project are housewives suggests that their new roles have been accepted and supported by the male members of their respective households and the community at large.

From the analysis, it has been established that water is the life-blood of any community so is it in Kitui district. Its development occupies the number one position in priority ranking of projects in Kitui district. The necessity of water availability for survival of both man and animals is common knowledge. From the analysis, food ranked the highest closely followed by water as basic needs. Clothing and shelter occupied positions three and four respectively.

Distance to water source emerged as a major determinant in choice of water source. Quality and quantity followed in the second rank, as reliability of the water source ranked third. Other mentioned factors included opportunity for multiple use and lack of other alternatives. Time taken to and from water source and depth of scoop holes in the catchment areas are major determinants of water quantity.

The above observations are in line with SASOL's objectives even though quality of water was not among the set project goals. The project design clearly stated that quality of water would be dealt with once water was provided to households at a distance of less than two kilometres.

Stocktaking attempt aimed at establishing owned farm implements that are necessary in the sand dam project established that 90% of the respondents own the same. These implements range from jembes, mattocks, and spades to ox-ploughs. This has a direct bearing on project implementation because participants use their implements while working on the project. Some respondents reported that at times the inadequacy in digging implements in terms of quantity and quality acts as a limitation to their work. Tough implements are sometimes required for breaking hard rocks.

Study findings show that on average, over 50% of the community members cannot afford decent building materials. This is supported by the high percentages of those using brick and mud as the wall materials for their main house. Most residents are able to make bricks particularly after construction of the sand dams, while majority cannot afford cement and iron sheets. This accounts for the high percentages of those using bricks and mud in construction of their houses among the participants. The very high percentages of those living in un-cemented houses (an indicator of poor housing condition) are also indicative of the poverty levels in the district. The cost of cement seems not to be economically feasible for over 60% of all the respondents in the study area.

It was further established that 97% and 98% of the participants and non-participants respectively use wood as the main source of energy. Kerosene use was ranked as the second most used source of energy. Use of charcoal fuel was limited to a smaller percentage of the households.

Migration rates are minimal in both the project and baseline areas. The number that migrated did so in search for employment. Land inadequacy was also cited as another cause for migration.

Permanent migration has been witnessed due to land inadequacy and sometimes in search of fertile lands. Temporary migration in some cases is a drought coping mechanism in Kitui. Data for both participants and non-participants indicate that the burden of water fetching still rests in the female domain, that is women and girls both before and after the project, as reported by half of the respondents.

The main means of transporting water in Kitui are donkeys, human labour and ox-drawn carts. Possession of a donkey or a cart looked more of a basic requirement other than an indicator of any particular status or wealth.

As far as direct impact of the project is concerned, it was found out that most households in the project area are now relying on sand dams as the main source of water during the dry season. During the wet season, there are other alternative sources of water although most of them are open to contamination.

There is a marked increase in water consumption after the initiation of the project. The sand dam project saw households living in the project area use more water in a day than their counterparts in the water scarce baseline areas of Mutomo and Yatta.

The project has made life easier for most of the residents in the project area compared to the counterparts in Yatta and Mutomo divisions. Those who were trekking for long distances to water sources are now able to get water from manageable distances i.e less than two kilometres from their homes. The need for improvement of water sources in Yatta and Mutomo is paramount. Water searching is no longer consuming the largest share of time as the case was before the project Increased water availability releases time spent in water fetching activities. Households have the freedom to choose between engaging in leisure, sleep or other economic activities.

Diversion of saved time from tedious water fetching activities is a positive externality of the sand dam project. If the incomes from the enhanced economic activities could be calculated, it could be a major addition to the households' annual income and is going a long way in improving the incomes and welfare of people living in the project area.

There emerged a consensus among all categories of respondents in both the project area and baseline area that trekking of girls for long distances in search of water is bad. The activity puts the lives of girls at a risk; it has a negative impact on their health, chances of being raped are high and the exercise sets a negative socialization environment for girls leading to unwanted pregnancies. The project, as evidenced by the data, has managed to reduce the risks faced by girls while trekking for long distances while searching for water. Girls are no longer facing the tiring journeys to water sources. The said risks are still faced by girls in the baseline area.

The construction of sand dams in the project area has reduced the depth of scoop holes to less than two. The water table is higher than before. Thus people are able to access water without difficulties. This has also reduced the risk posed by the collapsing of the walls of the scoop holes. The shallow scoop holes require only one person to access the water compared to the situation before.

The project has reduced water rationing in the project area by a big margin. This has an impact on sanitation. Water rationing compromises quality of sanitation in households as many

household members are forced to go without taking a bath for days while water has to be recycled. After the project, participants are able to consume more water than before compared to the baseline area, where water rationing is pronounced.

As far as accessibility is concerned, there are no major problems except in some few isolated cases. Majority of the people who participated in the sand dam project are satisfied and are contented that their efforts have bore fruits.

On the economic side, the analysis has established introduction of and increased vegetable growing and kitchen gardening in some catchments. Production of crops like *sukuma wiki* (kale), tomatoes, *ndania* (coriander), spinach and onions among others, has started in large scale. Given the rate at which people in the project area are turning to vegetable growing, apart from being self-sufficient in vegetable production, Kitui District will soon start exporting vegetables to other districts as clearly shown by Kamale in Ithumula Maluma sub-location. Importation of kales, tomatoes and onions seems to be a thing of the past for Kitui town. There is no doubt that this is the greatest achievement of this project. The economic impact of this technology simple as it makes mockery of the " expensive and unsustainable elite based technologies" past initiatives have made in alleviating water shortages in ASALs. One of the potential bottlenecks is a weak marketing system and the market information flow for the producer. This poses a challenge to SASOL and other development partners. There is need to come up with community based, controlled and sustainable institutional structures capable of documenting production and marketing data, training farmers on the best production methods, monitoring market trends and communicating appropriately to farmers.

Other introduced economic activities include fishing for subsistence purposes and brick making. However, subsistence agricultural farming still remains the major economic activity in the region. Livestock production, historically the major production activity in Kitui district, has been declining due to increased population pressure. It never recovered the forced sales to feed the colonial army during WW11 and the loss of grazing lands in the Tsavo Park. However, respondents reported recent acquisition of improved livestock breeds for milk due to availability of water, which ensures that they do not loose condition as they track vast distances to watering points, and the planting of Napier grass along river banks for both river erosion protection and supplementary livestock feed. A few farmers are keeping these Bos Taurus animals and it is expected that the district may be self sufficient in milk in the near future. It should be noted that due to absence record keeping it proved difficulty to the respondents to gauge the contribution of these activities to the family incomes in detailed form.

Fishing is bound decline as the dams fill up with sand. *Sukuma wiki* growing, bee keeping, brick making are bound to increase with time. These activities are interrelated, as people's incomes increase from vegetable growing, bee keeping and selling of bricks, more decent housing will follow thus triggering the demand for building bricks.

The incomes accruing from these improved and new economic activities have a positive impact on the family unit. The respondents reported that the income accruing from production made possible by the project is used in paying school fees, construction of better houses, and for starting income generating activities among other uses. Very few cases were reported of negative impact.

Cost of water reduced drastically after the sand dam project. This was because of the reduced effort of fetching water by the vendors and households, which was prompted by shorter distances trekked in search of water, and lesser waiting time due to increased infiltration rates. This implies that the beneficiaries are directing the extra money they were spending on water to other needs. Likewise this has enabled them to consume more water.

How much are people willing to pay for improved water supply systems? In normal circumstances, where levels of income are high, willingness to pay for improved water supply system increases with water scarcity. However, this was not the case. In the project area, respondents were willing to bid low amounts of money. This could be explained by the fact that water is not a big problem and their incomes are low. However, separating the contribution of each reason to general low bids remains a challenge. In Mutomo and Yatta respondents were expected to quote higher figures, which was not the case. This is explained by low income earned by households in these two very dry divisions.

Cases of unintended positive outcome from the sand dam project were reported. These include respondents reporting that the value of land and animal reproduction rates improvement. Cases of people buying land after the construction of the dams ere also reported. Leasing land for purposes of growing vegetables was alluded to. However, it was reported that some new members pay a user fee after leasing or buying land within the project area if they have intention of using the water.

In management of sand dam project, issues concerning the dam committee members were discussed. Main factors considered by the members while choosing dam committee members are the ability to lead, maturity, honesty, hard work/commitment/participation/active among others.

The most desirable factor considered while choosing a secretary was literacy. Other attributes, which were mentioned, though to a lesser extent were good listener, honesty, sociability, patience, faithfulness, love and devout Christian. For the Treasurer, the most desirable attribute reported was wealth, obviously a proxy for security of the contributions. The other seemingly important requirements were literacy and commitment to the Christian faith, politeness, sociability, and mature people without small children.

Majority of the committees were found to be dormant. This has a heavy implication on issues related to marketing of the project proceeds if they are presumed to evolve to higher levels of complex organization, thus organizing marketing for the proceeds resulting from use of the availed water. Horticultural crops being produced by the member are perishable and require an organized and fast delivery system to markets.

Dam committee members appreciate that the training they received from project initiators while implementing the project is beneficial to them in terms of gaining knowledge. It is also evident that the dam committee members do not benefit in any special way from the rest of the members.

Review of the training material used initially for training shows that the content was not sensitive to some of the aspects of committee composition like age and gender initially. However, a review of the training material used in the areas where the project was implemented later show that all these aspects are put into considerations while forming the project dam committees.

Respondents identified the following as the factors which promote community cooperation; hard work, commitment, unity, peace and good leadership. Hard work, unity commitment and peace score high percentages among all the categories of respondents. The factors which act as obstacles to community cooperation are political party affiliation, gossip, lack of respect, poverty, diseases, hatred, poor leadership, illiteracy and /or ignorance and corruption. Ignorance/illiteracy, poor leadership, poverty and corruption are mentioned as the major obstacles.

Community leaders grow old while others die, thus the stock of leaders has to be replenished from time to time. The results point out that communities try to train people for leadership by giving them opportunities to lead in committee while working with the experienced people. In some areas it is only people leaders who are trusted with new leadership positions while in other areas, people without leadership experience are considered for the same.

Participating in project is very beneficial. Other than achieving the objective, which brings people together, participants also benefit in other not initially intended ways. In this case, by coming together to implement the sand dam project, the process has set into motion a number of other activities. These benefits include making new friend who form groups to assist each other in *shambas* and other community work.

Water points especially wells and unfilled sand dam can be a great source of danger if care is not taken while using them. Asked the kind of plans they put in place to avoid negative consequences, the respondents gave a variety of responses. Some said that children are not allowed to play near the sand dams to avoid cases of drowning; only participants have access to the water. Where there are wells, respondents said that the wells are covered with lids. Participants are now protecting their water points by fencing particularly during the dry season. During the wet season most people use unprotected sources.

Soil conservation activities have been kicked up to higher levels among the participants. This was as a result of the training they have received during the process of implementing the project. However, these activities are limited to terracing, tree and grass planting.

To determine whether communities are in control of their water resources, participants were asked the forms of action the community would take in case any one was found polluting the water source. The data sheet enumerated the following sources of pollution: washing inside the dam/well, washing clothes inside the dam/well, watering animals in the well/the dam, spraying chemicals around the dam/well, defecating/urinating near the dam/the well and dropping objectives in the source. The actions the members would take included reporting the culprit to the provincial administration, beating up the person, excommunicating him/her from using the water points or forcing him to pay some fine. It is interesting to note that almost all the participants thought of some action that they would take against polluters. The severity of the action varied across various participants and was somehow mild among the non-participants in the baseline and the project area.

It was established that majority of the participants alluded to the fact that community members owned sand dams. Only a few respondents cited SASOL as the owner of the dams. This could be attributed by the fact that SASOL supplied what the community considered to be the most important ingredients to the project, cement and reinforcement bars as well as masons and supervisors.

The study wanted to find out weather participants had attachment to the sand dams. To establish this, they were asked the minimum amount of money they would be willing to accept as compensation for the loss of their main source of water. This question also endeavours to establish existence of alternative sources of water. Where the figure stated is low, it means there are other sources of water, not too far from the respondents. The results from this section point to the fact that neither the males nor females in the project area could accept a cheap compensation. They could not stand the sight of what they expended a lot of efforts being destroyed. They were satisfied with the project and could not imagine receiving compensation instead of continuing to reap the benefits accruing from the project.

Issues concerning waterborne disease mitigation measures are also discussed in this report. It is important to note that majority of the household know the dangers posed by drinking unsafe water. However, waterborne diseases mitigation measures are limited to water boiling. The wholesomeness of water depends of many factors. Disposal of human waste is one of the factors affecting quality of water. If care is not taken, it impacts negatively on health. Data enumerators were required to make observations on the same and record their observations. Nearly half of the respondents do not have toilets in their households.

Concerning operation and maintenance, participants were torn by indecision concerning the sources of funds for operation and maintenance. Some cited that the dam committee members were responsible while others mentioned community members. But the most important conclusion is that sand dams require minimal operations and maintenance resources.

There is link between dam committees and other committees in the community. This may result from the fact that the dam committee members may be invited to participate in other committees without the consent of the dam members thus limiting members awareness about the relationship between the dam committees and other committees in the rest of the community. Dam committee members opinions are sought when important community development decisions are being made. Further, dam committee members have been incorporated into other committees in community.

The training of dam committee members has benefited the community in the project area in a number of ways: one, it has assisted the community to identify community leaders; the trained leaders are now able to participate influencing the development agenda in their communities. This data points out clearly that there is a relationship, which is developing between dam committees and other community committees in the project area. The seeking of the opinion of the dam committee members indicates that the communities have been impressed by the performance of the dam committees. Like wise, the giving of leadership positions to dam committee members in other community committees points to the same. On the other hand, the tapping of leaders from other committees into the dam committees shows that the communities recognize the importance of involving these leaders in the success of the project. It is a logical conclusion then that there is a symbiotic relationship between the dam committees and other committees in the community.

The story of sand dams is an example of positive reaction to drought caused misery and distress. Since 1995, women and men have taken action for survival. The Kitui community has proved less conservative and more adaptive to change. Nothing seems to be too difficult. Men are accepting less dominant roles in development work.

It is worth to note that times are changing. It is naïve for anybody to underestimate or disregard women in rural development. Women are becoming increasingly vocal concerning their rights and expectations in life; their needs; and wishes. This is prompted by the new challenges placed before them by changing physical and economic conditions. In face of the increasing scarcity and hardships in securing family survival, the norms that dictate the behaviour of women and men appear to change. Norms that make women remain invisible and bar them from engaging in productive activities, and those, which discourage men from participating in kitchen, duties are getting relaxed.

However, this is not to be misconstrued to mean that women in Kitui are becoming domineering or uncooperative in their families. Rather, this has given them a chance to reason out together for the survival of the family unit in front of these new challenges.

The marginal low potential and vulnerable areas (that is Yatta and Mutomo divisions) of Kitui district should not be neglected in water development. Continued neglect of these areas will worsen environmental destruction and will continue to perpetuate poverty. There is growing evidence that agricultural intensification in fragile lands is possible and that degraded natural resources can be rehabilitated (IFPRI, 1995). Water provision using the right technologies is the key to long-term solution to some of the problems facing people in these areas (Muller, 1997).

The impact of increased supply of water to diseases proved elusive. This is because increased quantities of water have two opposing effects. Increased quantities of means enhanced hygiene implying reduced chances of people becoming sick. On the other hand, with increased quantities of water, people are exposed to water borne diseases increasing their chances of getting ill. Coming up with the appropriate methodology and applying the same in the sand dam project will be a fruitful area of further research.

11.2 CHALLENGES AND RECOMMENDATIONS

From this study it has been established that the sand dam technology is suitable, in socio-economic terms, for provision of water in Arid and Semi Arid Lands (ASALs). The Delft University of Technology[14] research team has lauded the approach from an engineering point of view. Suitability is primarily driven by the technology. It is easy to construct, operate and cheap to maintain. Its maintenance and operational needs meets the local expertise and resources endowment. Other development partners are encouraged to replicate this technology to other ASALs. However, this technology is only applicable to areas networked by ephemeral rivers and streams without black cotton soils for the masonry dams sink in these soils. This poses a serious challenge to planners, policy makers and development partners to come up with a comparable technology suitable to areas dominated by black cotton soils.

The participatory nature (involving the local communities in the formulation, design, implementation and maintenance) of the sand dam project is laudable. This encourages ownership and control of development projects by the locals. It also checks chances of privatisation of dams. Cases of wealthier community members "volunteering" to provide almost the entire requirements must be discouraged as is practiced now for it limits ownership of

[14] Read Beimers P.B. et al (2001): *Practical Work Report- Building Sand Storage Dams*; and *Sand Storage Dams in Arid and Semi Arid Areas- A manual on Location choice, Design, Construction and Maintenance of Stone-Masonry Dams* Unpublished reports by students from the Delft University of Technology

development projects by local communities and enhances chances of privatisation once the development partner pulls out.

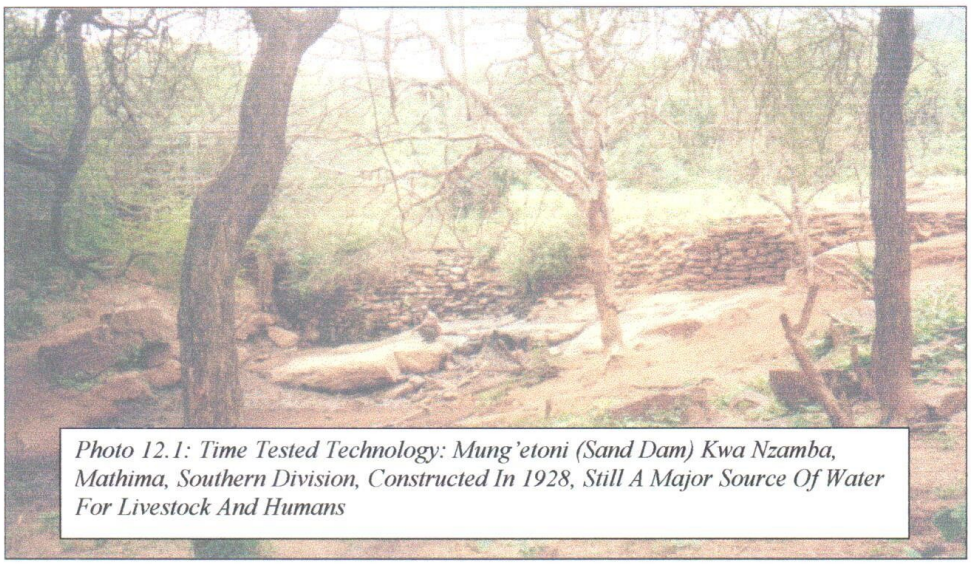


Photo 12.1: Time Tested Technology: Mung'etoni (Sand Dam) Kwa Nzamba, Mathima, Southern Division, Constructed In 1928, Still A Major Source Of Water For Livestock And Humans

SASOL left the selection of training participants to community processes without guidelines at the beginning. Later some age, gender, literacy and record keeping criteria were given out to communities to use in selecting trainees and committees. Training has to be enhanced to cover more participants so as to impart greater sense of care and willingness to maintain the sand dams and other community projects. As new leadership needs emerge e.g. on marketing of the products using water from the completed dams, greater attention to training for community institutional capacity building to handle a variety of problems needs to be thought out and put into place.

The local communities must continue to be given the opportunity to continue contributing locally available resources like labour in breaking stones and collection of water, stones and sand. This makes the communities feel that they have a stake in the entire project.

Low frequency of the dam committee meetings was reported. Indefinite tenure in office was reported too. This limits the scaling-up effects of the training imparted. Even though the sand dams might not require constant attention, it is important to beef-up the frequency of the committee meetings to possibly four to six times in a year. The duration in office of the committee members must be limited to two years to give other community members a chance to lead. At the same time it is felt that the dam committees are the best placed for elevation to higher levels. The dam committee members should be trained on data collection and keeping. Information on market trends should also be passed through them.

There is need for SASOL to address the physical and bacteriological quality of water in the already built up area. There is need to address the issue of pumping facilities at the wells. For improved hygiene, it would be better to keep the wells totally closed other then the current system of using winches.

The training offered to communities on natural resource management, leadership and sanitation, was very important for purposes of creating a construction regime. It is not clear that it is responding to management of operations and maintenance needs–perhaps because there is little to do- or whether it is spreading as fast as is necessary to those who were not privileged to have been be trained. For example, almost everybody knows that drinking unboiled water is not safe, but still significant percentage of respondents do not boil drinking water! This poses a new challenge to trainers to address retention and adoption of past training and to chart new pathways.

Other communities must be sensitised on the changing roles in development process. Communities should no longer wait for the Government or other development partners to initiate or take lead in local development projects. The sand dam project points that with support communities can organise themselves to solve their water problems and thus fight poverty. For as long communities continue to believe that the responsibility of tackling poverty lies in the hands of the Government poverty levels among them will remain high.

Box 8: Poverty

Poverty is hunger. Poverty is lack of shelter; poverty is being sick and not being able to see a doctor. Poverty is not being able to go to school, not knowing how to read, not being able to speak properly. Poverty is not having a job, is fear for the future, living one day at a time. Poverty is loosing a child to illness brought about by unclean water. Poverty is powerlessness, lack of representation and freedom.[15]

Future training –perhaps as a completely new project activity- should be expanded to include *inter alia*:

1. **Comprehensive Catchment Water Management**:
   For the purpose of comprehensive management of water resources, catchment committees should be formed. This will ensure that water is managed well for the benefit of all those involved. This will ensure that water-harvesting efforts of one group are not destroyed by other(s) group(s). Water quality, soil erosion, catchment vegetation cover, will be more effective and rewarding if managed on catchment basis. Using these committees, it is possible to prevent deforestation and over exploitation of forests and all other natural resources.

2. **Catchment Conservation:** Local communities must be taught to enhance soil conservation practices. These include terracing, grass planting and conservation methods etc for sub catchments. Partial adoption of the techniques will mean that the whole population will not benefit for conservation techniques produce maximum benefits if adopted by whole catchments.

3. **Operation and Maintenance Skills**: Sand dam technology requires little operational and maintenance skills. However, communities must be equipped with simple operation and maintenance skills. From observation it was noticeable that some individuals use the barricades as *Panga* sharpeners and paths. This weakens dam walls. The need to plant grass/Napier grass along the riverbanks must continue to be emphasized. It is strongly

[15] Republic of Kenya, Poverty in Kenya: Report on District Dissemination Workshops- Ministry of Finance and Planning and GTZ, December 1999

recommended that project members should be on the utilisation of Napier grass as a folder crop for their livestock. Currently participants are not making extensive use of it.

4. **Disciplinary Measures:** It was established that 50% of the respondents were not willing to take any form of action if the community water source (sand dam) is misused. This probably could be attributed to either lack of knowledge of various avenues of the dealing with offender or the ineffectiveness of the provincial administration in taking action. This calls for a more in-depth and systematic study to establish the actual cause of this problem

5. **Empowerment:** This involves decision-making and control of resources. Training would enhance swiftness in decision-making and participation. Cases of some household heads (women) needing to consult spouses living outside the project area were encountered. In some cases the control of resources is bestowed upon individuals working outside the village. This may lead to delay in community project implementation. To beef up participation levels, training should aim at empowering household heads (those residing in the household) in the baseline area.

6. **Utilisation of Water Created Opportunities:** The communities must be imparted with skills aimed at tapping the created opportunities and ways of coping with challenges resulting from the project. The innovative respondents have embarked on vegetable growing, brick making and bee keeping among other activities. It was established that in some areas, there was limited utilisation of the availed water. Cases of farmers loosing their entire crop of vegetables to pests and diseases were also reported. It must be noted that these farmers are venturing into new practices that they have little experience. Needs on these issues should be identified in a participatory manner and if necessary farmed to other institutions to implement for the core business of SASOL is water source provision.

7. **Sanitation:** As available water quantities increase chances of pollution are increased. Cases of people bathing or washing clothes near the water sources using detergents (potential pollutants) where reported. It was also established that almost half of the households do not have toilets in the study area. It was interesting to note that presence of toilets in some communities is not strongly related to the levels of incomes. It was found that the need for toilets comes naturally as a result of deforestation (deforestation reduces alternative hideouts to answer calls of nature). Training on sanitation is complete, but retention and practice remains a major challenge.

8. **Water Borne Disease Mitigation Measures**: Increased water quantities have two opposing effects on health. Increased water levels might increase health status if followed by improved sanitation. Potentially, the provision of more water can increases incidences of water borne diseases. From the survey data, it was found that 78% of all respondents are only boiling drinking water. Other mitigation measure like destroying mosquito breeding grounds, use of mosquito nets (to families that can afford), hand washing after going to the toilet etc must be emphasized.

9. **Community Development Plans**: Local communities must be encouraged to develop local community development plans and ways of implementing them either on their own or in collaboration with willing development partners.

Emulating the lion's vision
The eagle's forbearance
Let's break out of the shells
Let the fire of our fortitude
Afford us prosperity
That we may not forever bask
In the glory of others

Each is endowed with wings
Inborn wings
Stretch them out, try them
You never behold the height of your flight
Till you behold the might of your wings
Press on!

The light at the end of the tunnel
Remain opaque till we shed self-made walls
Bud on!
The crowning morsel
Could be much, much more
Than you bargain for.

By Caroline Wanjiru, FAWE (1997)

Till taught by pain, men know not water's worth

(Anonymous)

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APPENDICES

Appendix I: TERMS OF REFERENCE

OBJECTIVES AND THE SCOPE OF THE STUDY

The Study will be more complex than an ordinary impact assessment study for it will seek to analyse data being collected by communities, collect historical data about the area and then deal with specific impact data to generate policy options for similar areas which form 83% of the country. The central aspects of concern in this study are sustainability, gender and poverty eradication.

Main Objective

The main objective of the study is to systematically establish whether the project has had social and economic impact in terms of: -

- Increased land output through sustainable agriculture based on optimal use of local resources and natural processes and safe efficient use of external inputs;
- Empowerment of local communities (female and male farmers) who seek to build their future on basis of their own knowledge, skills, value, culture and institutions; and
- How the production is impacting on the standards of living of the local inhabitants.

Secondary Objectives

- Carry out a constant production share analysis to establish whether there exists trade-off between agriculture and livestock production in the period before and after the construction of the dams.
- Establish how the time and effort saved from reduced water distances is utilized.
- Assess how the increased incomes accruing from increased land output impact on the stability of the family unit, the youth and the welfare of the women and children in the project area.
- Establish how the communities constitute and balance (gender and social stratification) in the dam committees; and the attitude of the community members towards the management style and sustainability of the dams.
- Measure the degree of integration among stakeholders (community, government, and development agencies) in the project area.
- Investigate whether the created opportunities act as incentives to attract people living outside the project area to either acquire or lease land for strategic reasons.
- Identify whether there is organizational, production and social scaling up including influencing policy at the micro, meso and macro level; and to establish the policy implications of all of the above at micro, meso and macro levels.

METHODOLOGICAL CONSIDERATIONS

This study will draw data from sampled household in the project area. A representative number of dams will be sampled using stratified random sampling technique based on the four catchment areas. For the purpose of obtaining a comprehensive picture of social and economic impact of the sand dams, inter-

method triangulation (application of both qualitative and quantitative methods in data collection) approach will be adopted.

The construction of the survey instrument will be in three stages. First will be desk study on all past research in the project area. Data on local production, collected by community groups will be analysed. In the second stage, a limited number of questionnaires will be administered to elicit information from the sampled households in the catchment area, while in the third level, Focus Group Discussions will be held to amplify and confirm the emerging issues.

Data analysis will employ both descriptive as well as econometric regression analysis. This will yield both descriptive and inferential statistics that will be used in making predictions and conclusions necessary to answer the study questions. Probabilistic variables will be analysed using discrete choice methodology.

Appendix II: The Study Sample

DIVISION: CHULUNI
(Number of Households = 12,977; Sample Size = 1,298)

Location	Sub-locations	No. Households	Sample
Nzambani		4,229	423
	Kyanika	1,643	164
	Maluma/Ithumula	1,969	197
	Ngungi	617	62
Nzangathi		1,497	150
	Nzangathi	1,497	150
Mbitini		3,231	323
	Kanzau	534	53
	Mbitini	1,303	130
	Katwala	922	92
	Mosa	472	47
Kisasi		2,149	215
	Ngangani	593	59
	Kitungati	750	75
	Masimbini	806	81
Mbusyani		1,871	187
	Ngiluni	490	49
	Mbusyani	589	59
	Nguuni	490	49
	Mukameni	302	30

DIVISION: CENTRAL
(Number of Households = 20,683, Sample Size = 2,068)

Location	Sub-locations	No. Households	Sample
Kyangwithya West		3,494	350
	Mbusyani	326	33
	Tungutu	1,282	128
	Utooni	783	78
	Mulutu	732	73
	Ndumoni	371	37
Kyangwithya East		5,802	580
	Ivaini	795	80
	Museve	1,065	107
	Kaveta	862	86
	Misewani	1,193	119
	Mutune	734	73
	Mulundi	1,153	115
Maliku		1,927	193
	Kavisuni	709	71
	Maliku	542	54
	Kathungi	676	68
Mulango		2,870	287
	Kyangunga	581	58
	Wikililye	1,374	137
	Wii	370	37
	Kyambiti	545	55
Katulani		1,582	158
	Katulani	1,059	106
	Kwa Muli	523	52
Itoleka		1,579	158
	Kavuta	491	49
	Itoleka	1,088	109
Miambani		3,429	343
	Kenze	613	61
	Mutula	678	68
	Kamandio/Malili	952	95
	Munganga	601	60
	Nzaaye	585	59

DIVISION: YATTA
(Number of Households = 7,648; Sample Size = 765)

Location	Sub-locations	No. Households	Sample
Yatta		3,177	318
	Nyanyaa	432	43
	Makusya	708	71
	Ilika	1,002	100
	Ndunguni	1,035	104
Kwa Vonza		1,376	138
	Mikuyuni	946	95
	Kanyonyoni	430	43
Kanyangi		3,095	310
	Syomunyu	1,287	129
	Mandongoi	1,808	181

DIVISION: MUTOMO
(Number of Households = 14,869; Sample Size = 1,487)

Location	Sub-locations	No. Households	Sample
Mutha		878	88
	Katene	268	278
	Kalambani	111	11
	Ngaani	499	50
Ndakani		1,062	106
	Isaa	271	27
	Kalia Katune	319	32
	Ndakani	472	47
Mathima		1,447	145
	Mivuni	348	35
	Kiimani	284	28
	Kivyuni	261	26
	Kengo	280	28
	Kiati	274	27
Mutomo		1,301	130
	Kandae	165	17
	Kitoo	645	65
	Mwala	491	49
Kibwea		1,934	193
	Kibwea	755	76
	Kawelu	1,179	118
Kyatune		2,134	213
	Yongela	395	40
	Ngwani	575	58
	Kyatune	895	90
	Ndatani	269	27
Ikanga		3,085	309
	Kathungu	1,386	139
	Ilusya	1,068	107
	Ithumula	631	63
Voo		1,874	187
	Nthunguni	508	51
	Kyaango	476	48
	Kyangini	220	22
	Imale	199	20
	Kasasi	471	47
Kyamatu		1,154	115
	Kyamatu	455	46
	Nzanzu	194	19
	Muthungue	505	51

DIVISION: IKUTHA
(Number of Households = 9,456; Sample Size = 946)

Location	Sub-locations	No. Households	Sample
Kanziko		1,126	113
	Kivandeni	288	29
	Mwanianga	231	23
	Kanyaa	82	8
	Keutunda	373	37
	Kituvwi	152	15
Simisi		739	74
	Ilamba	107	11
	Simisi	270	27
	Ekani	362	36
Kasaala		1,058	106
	Uyini	358	36
	Kasaiani	342	34
	Nzamba	358	36
Ikutha		2,145	215
	Ngwate	491	49
	Ndili	493	49
	Maiani	115	12
	Ngawuni	198	20
	Kyoani	462	46
	Kiangu	386	39
Maluma		1,249	125
	Maluma	680	68
	Muambani	333	33
	Monguni	236	24
Kalivu		1,190	119
	Kalivu	533	53
	Makaie	397	40
	Katilini	260	26
Athi		1,949	195
	Kilawa	567	57
	Kituti	971	97
	Kisiio	411	41

Appendix III (a): Participants' Questionnaire

Household No. _____ Village: _____

Sub-location: _____ Location: _____

Division: _____

1.0 Name of the respondent:

2.0 Household Demography:

Member No.	Sex	Marital Status	Age	Education	Occupation		Annual Income
					Main	Secondary	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

3.0 Sources of Annual Family Income:

Sources	Annual Income (in Ksh).	Ranking
1. Business		
2. Regular Employment		
3. Wage earner		
4. Crop Farming		
5. Livestock		
6. Others (specify).		

4.0: Assets Inventory and other household possessions:

i) Type of Housing

House	Iron Sheets	Grass thatched	Cemented	Un-cemented	Tiles	No. of Rooms	Walls
Living House							
House 2							
House 3							
House 4							
House 5							
Toilet							

ii) Other family possessions

Characteristic	Number
Chicken/Ducks	
Goats/Sheep	
Donkeys	
Cows	
Jembes/Spades/Mattocks	
Plough	

Bicycles	
Carts	
Plant machines (Posho mill)	
Motor vehicles	
Transistor Radio	
Television set	

iii) Household Land Ownership and use

Land use	Owned (Acreage)	Rented (Acreage)
Homestead		
Agriculture		
Livestock		
Fallow		
Other (specify)		
Total		

iv) Source/s of Energy

Source	Check (✓)
Firewood	
Charcoal	
Kerosene	
Gas	
Solar	
Electricity	
Bio-gas	
Other (please specify)	

v) Information on food intake and nutrition
(Note: The interviewer to sample local market to trace the sources of foodstuffs)

Household's average common diet per week

Breakfast		Lunch		Dinner (supper)	
Type of food	Value (Ksh)	Type of food	Value (Ksh)	Type of food	Value (Ksh)

vi) Food preparation, service and order of service over one week (Rank or check where applicable)

Party	Preparation	Serving	Order of taking meals
Husband			
Wife			
Children			
House-helps			
All of us			

5.0 Information on Rural Migration:

a) Has any member of the family migrated elsewhere since 1990?

Yes [ ] No [ ]

b) If yes, when? _____ If No, go to Question 6.0

c) Fill in the following table

No.	Permanent	Working outside the Location	Temporary (Seasonal)	Place of settlement			Reasons for migration
				Village	Town	Abroad	

6.0:

i) Water Uses

Water use	Quantity - Proportion (%)
Cooking	
Cleaning	
Drinking	
Washing	
Livestock watering	
Others (Specify)	

ii) Source, Distance, Time and Number of Trips

Dry Season				Wet Season			
Source	Distance	Time	Trips	Source	Distance	Time	Trips
Rivers				Rivers			
Piped				Piped			
Roof Catchment				Roof Catchment			
Bore hole				Bore hole			
Well				Well			
Earth Dam				Earth Dam			
Sand Dam				Sand Dam			
Rock Catchment				Rock Catchment			
Scoop-holes				Scoop-holes			

iii) Quantity, Quality and Uses

Dry Season				Wet Season			
Source	Quantity	Quality	Uses	Source	Quantity	Quality	Uses
Rivers				Rivers			
Piped				Piped			
Roof Catchment				Roof Catchment			
Bore hole				Bore hole			
Well				Well			
Earth Dam				Earth Dam			
Sand Dam				Sand Dam			
Rock Catchment				Rock Catchment			
Scoop-holes				Scoop-holes			

iv) How and who fetches water

Who	Check	Ranking/week	Means	Check
Husband			Human	
Wife			Donkey	
Boys			Cart	
Girls			Motor vehicle	
House-helps			Bicycle	

7.0: Factors influencing the choice of water source and ranking:

Factor	Dry Season Ranking	Wet Season Ranking
Distance		
Multiple use		
Quality		
Reliability		
No alternative		

8.0: Depth of Wells:

Dry season (ft)	Wet season (ft)

9.0: Water rationing:

Dry season	Wet season
Yes [ ] No [ ]	Yes [ ] No [ ]
If yes, explain how:(Probe to know the origin of rationing design)	If yes, explain how: (Probe to know the origin of rationing design)

10.0: Sanitation:

Aspect	Dry season	Wet season
Cloth Washing		
Body Washing		
Utensil Washing		

11.0: Protection of water points from contamination:

12.0: Soil conservation:

Measure	Number
Terraces	
Trees planted	
Misonzo	
Grass planting	Check (√)

13.0: i) Water related diseases occurrences per year:

Type of disease	Cost of treatment	Time laid off
Cholera		
Typhoid		
Conjunctivitis		
Scabies		
Schistosomiasis		
Malaria		
Trypanosomiasis		

ii) Waterborne diseases- mitigation measures- Explain:

14.0: Do you have local water source management committee?

Yes [ ] No [ ]

If not, go to question 20

15.0: i) The mode of choosing water source committee members:

Mode	Check (✓)	By whom?
Nomination		
Election		
Selection		
Other (Specify)		

ii) The duration in office of the office bearers:

_____ Months/Years

iii) Committee members eligibility conditions:

List down the legibility conditions	

16.0: What is your attitude towards the committee in regard to the following:

Characteristic	Positive/Negative
Composition	
Operation	
Accountability	
Transparency	
Commitment	
Nepotism	
Patience	
Greedy	
Maturity and good communication	
Listening to people needs	
Bossy	
Ready to serve others	
Care and respect for people and property	
Corrupt	

17.0: How has the formation of the committees impacted on the Integration of the community in terms of:

Aspect	Comment
Age	
Religion	
Political party affiliation	
Social status	
Gender	

18.0: Does the community give chance to the people who have not had an opportunity to lead?

Yes [ ] No [ ]

19.0: i) Are there linkages between the committee and other community committees

Yes [ ] No [ ]

ii) If yes, explain

_____
_____
_____

20.0: Are you a member of any community group?

20.0: What other general benefits have you realized as a result of the community coming together?

_____
_____
_____

22.0: i) Does the community have influence on its development agenda?

Yes [ ] No [ ]

ii) If yes, explain

_____
_____
_____

23.0: How is the increased water availability impacting on the family unit?

Aspect	Check
Health	
Cleanliness	
Leisure	
Children school absenteeism	
Children school punctuality	
Cooking at the right time	

24.0: How is the increase in availability of water impacting on the following social aspects?

Aspect	Impact
Security	
Pregnancy rates	
Community cohesiveness (micro/macro levels)	
Marriages	

25.0 Was trekking long distances in such of water by girls regarded as good or bad?

Good [ ] Bad [ ]

Explain your answer and the impact of IWSS on the same?

_____
_____
_____

26.0: How frequently were you participating in social functions before and after the IWSS project?

Function	Frequency Before	Frequency After
Religious		
Market days		
Funerals		
Myethya		
Parties		
Harambees		
Visiting friends		

27.0: How many hours were you spending on sleep at home before and after the IWSS project?

Before the Project		After the Project	
Wet seasons	Dry seasons	Wet seasons	Dry seasons

28.0: Before participating in this project (building structure), whom did you consult?

Person	Check
Husband (In the household)	
Husband elsewhere	
Wife (In the household)	
Wife elsewhere	
Friends	
Local administration (Headman/Ass.chief/Chief)	
Religious leaders	
Other (Specify)	

29.0: What are the factors working for (promotes) or against community co-operation? - Rank them

Working for	Working against

30.0: List the economic activities before/after the sand dams project and their ranking?

Activity	Before IWSS (Rank)	After IWSS (Rank)
Agriculture		
Livestock		
Bee-keeping		
Vegetable growing		
Brick making		
Tree Nurseries		

31.0: What local factors influence the degree to which the IWSS benefits evolve? (Geographic; cultural; gender; economic; social; etc.)

Promoting	Rank	Limiting	Rank

32.0: What are the notable activities sparked off by the IWSS?

Activities	Contribution to family income (annually in Ksh)

33.0: Other indirect benefits accruing to the community alongside the improved water supply system?

Benefits	Check (✓) How
Increased land value	
Fatter livestock	

34.0: i) Have these benefits served as incentives for people living outside the project area to buy or lease land to harness these benefits?

Yes [ ] No [ ]

ii) If Yes explain.

_____
_____
_____

35.0: Are there some negative social and economic attributes (economic costs) resulting from the improved water supply system?

Yes [ ] No [ ]

If yes explain:

_____
_____
_____

36.0: How is the time saved from walking long distances in search of water used?

Activities	Contribution to family income (annually in Ksh)

37.0: Time budget:
Typical day in dry/wet season (% time allocation) before and after the IWSS

Before IWSS				After IWSS			
Dry season		Wet season		Dry season		Wet season	
Activity	Time	Activity	Time	Activity	Time	Activity	Time

38.0: What is/was the relative cost of paying somebody else to collect water on your behalf?

Before IWSS		After IWSS	
Dry season	Wet season	Dry season	Wet season
Ksh.	Ksh.	Ksh.	Ksh.

39.0: Is the use of the IWSS controlled and planned to avoid negative consequences to the society? (E.g. Unequal access; unauthorised use; overuse; environmental degradation around the water points; water contamination; conflict between water users).

Yes [ ] No [ ]
Explain your answer:

_____
_____
_____

40.0: What are the institutional and social implications of IWSS?
(Whether user groups and their rights are defined and agreed upon; operation and maintenance organised; and financing policy for users put in place).

_____
_____
_____

41.0: What services/goods are considered necessary for survival in the family?

Before the IWSS		After the IWSS	
Good/Service	Value	Good/Service	Value

42.0: Who controls the household's income and labour; and who decides the expenditure?
Check

	Before IWSS			After IWSS		
	Income	Labour	Expenditure	Income	Labour	Expenditure
Husband						
Wife						
Husband/Wife						
Boys						
Girls						
Mother-in-law						
Father-in-law						
Other (specify)						

43.0: What is the impact of increased family income on the family unit?

_____
_____
_____

44.0: Has the increased income/opportunities led to conflict at?

i) Family level Yes [ ] No [ ]

ii) Community level Yes [ ] No [ ]

If yes in (i) explain:
If yes in (ii) explain:

_____
_____
_____

45.0: If you never participated in the sand dams project, what are the laid down conditions for joining?

_____
_____
_____

46.0: What value do household attach to their sources of water?
Suppose your main water source was to be demolished and you're asked to move to the next nearest source of water, what is the minimum amount of money you would accept as compensation for the loss of the old source?

Ksh.	

47.0: Willingness to pay for IWSS
Suppose a certain development partner was to provide IWSS within 2 Kilometres from your household, what is the maximum amount of money would you be willing to pay towards this project?

Ksh.	

48.0: Willingness to manage water source.
a) Suppose you perceive that something is wrong with the management of your water source, what measure would you take as an individual?

_____
_____
_____

b) Suppose your elected/appointed to take up a leadership position in the water management committee, would you be willing to up the position?

_____
_____
_____

49.0: Any other comments?

_____
_____
_____
_____

Appendix III (b): NON-PARTICIPANTS' QUESTIONNAIRE

Household No. _____ Village: _____

Sub-location: _____ Location: _____

Division: _____

1.0 **Name of the respondent:**

2.0 **Household Demography:**

Member No.	Sex	Marital Status	Age	Education	Occupation		Annual Income
					Main	Secondary	
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							

3.0 Sources of Annual Family Income:

Sources	Annual Income (in KShs).	Ranking
1. Business		
2. Regular Employment		
3. Wage earner		
4. Crop Farming		
5. Livestock		
6. Others (specify).		

4.0: Assets Inventory and other household possessions:

i) Type of Housing

House	Iron Sheets	Grass thatched	Cemented	Un-cemented	Tiles	No. of Rooms	Walls
Living House							
House 2							
House 3							
House 4							
House 5							
Toilet							
Cow shed							

ii) Other family possessions

Characteristic	Number
Chicken/Ducks	
Goats/Sheep	
Donkeys	
Cows	
Jembes/Spades/Mattocks	

Plough	
Bicycles	
Carts	
Plant machines (*Posho* mill)	
Motor vehicles	
Transistor Radio	
Television set	

iii) *Household Land Ownership and use*

Land use	Owned (Acreage)	Rented (Acreage)
Homestead		
Agriculture		
Livestock		
Fallow		
Other (specify)		
Total		

iv) *Source/s of Energy*

Source	Check (✓)
Firewood	
Charcoal	
Kerosene	
Gas	
Solar	
Electricity	
Bio-gas	
Other (please specify)	

v) *Information on food intake and nutrition*
(Note: The interviewer to sample local market to trace the sources of food stuffs)

Household's average common diet per week

Breakfast		Lunch		Dinner (supper)	
Type of food	*Value (KShs)*	*Type of food*	*Value (KShs)*	*Type of food*	*Value (KShs)*

vi) *Food preparation, service and order of service over one week (Rank or check where applicable)*

Party	Preparation	Serving	Order of taking meals
Husband			
Wife			
Children			
House-helps			
All of us			

5.0 Information on Rural Migration :

a) Has any member of the family migrated elsewhere since 1990?

Yes [ ] No [ ]

b) If yes, when? _____ If No, go to Question 6.0

c) Fill in the following table

No.	Permanent	Working outside the Location	Temporary (Seasonal)	Place of settlement			Reasons for migration
				Village	Town	Abroad	

6.0:

i) Water Uses

Water use	Quantity - Proportion (%)
Cooking	
Cleaning	
Drinking	
Washing	
Livestock watering	
Others (Specify)	

ii) Source, Distance, Time and Number of Trips

Dry Season				Wet Season			
Source	Distance	Time	Trips	Source	Distance	Time	Trips
Rivers				Rivers			
Piped				Piped			
Roof Catchment				Roof Catchment			
Bore hole				Bore hole			
Well				Well			
Earth Dam				Earth Dam			
Sand Dam				Sand Dam			
Rock Catchment				Rock Catchment			
Scoop-holes				Scoop-holes			

iii) Quantity, Quality and Uses

Dry Season				Wet Season			
Source	Quantity	Quality	Uses	Source	Quantity	Quality	Uses
Rivers				Rivers			
Piped				Piped			
Roof Catchment				Roof Catchment			
Bore hole				Bore hole			
Well				Well			
Earth Dam				Earth Dam			
Sand Dam				Sand Dam			
Rock Catchment				Rock Catchment			
Scoop-holes				Scoop-holes			

iv) How and who fetches water

Who	Check (✓)	Ranking/week	Means	Check (✓)
Husband			Human	
Wife			Donkey	
Boys			Cart	
Girls			Motor vehicle	
House-helps			Bicycle	

7.0: Factors influencing the choice of water source and ranking:

Factor	Dry Season Ranking	Wet Season Ranking
Distance		
Multiple use		
Quality		
Reliability		
No alternative		

8.0: Depth of Wells:

Dry season (ft)	Wet season (ft)

9.0: Water rationing:

Dry season	Wet season
Yes [ ] No [ ]	Yes [ ] No [ ]
If yes, explain how: *(Probe to know the origin of rationing design)*	If yes, explain how: *(Probe to know the origin of rationing design)*

10.0: Sanitation:

Aspect	Dry season	Wet season
Cloth Washing		
Body Washing		
Utensil Washing		

11.0: Protection of water points from contamination:

12.0: Soil conservation:

Measure	Number
Terraces	
Trees planted	
Misonzo	
Grass planting	Check (✓)

13.0: i) Water related diseases occurrences per year:

Type of disease	Cost of treatment	Time laid off
Cholera		
Typhoid		
Conjunctivitis		
Scabies		
Schistosomiasis		
Malaria		
Trypanosomiasis		

ii) Waterborne diseases- mitigation measures- Explain:

14.0: Do you have local water source management committee?

Yes [ ] No [ ]

If not, go to question 20

15.0: i) The mode of choosing water source committee members:

Mode	Check (✓)	By whom?
Nomination		
Election		
Selection		
Other (Specify)		

ii) The duration in office of the office bearers:

_____ Months/Years

iii) Committee members eligibility conditions:

List down the legibility conditions	

16.0: What is your attitude towards the committee in regard to the following:

Characteristic	Positive/Negative
Composition	
Operation	
Accountability	
Transparency	
Commitment	
Nepotism	
Patience	
Greedy	
Maturity and good communication	
Listening to people needs	
Bossy	
Ready to serve others	
Care and respect for people and property	
Corrupt	

17.0: How has the formation of the committees impacted on the Integration of the community in terms of:

Aspect	Comment
Age	
Religion	
Political party affiliation	
Social status	
Gender	

18.0: **Does the community give chance to the people who have not had an opportunity to lead?**

Yes [ ] No [ ]

19.0: i) **Are there linkages between the committee and other community committees**

Yes [ ] No [ ]

ii) If yes, explain

_____
_____
_____
_____

20.0: **Are you a member of any community group?**

20.0: **What other general benefits have you realised as a result of the community coming together?**

_____
_____
_____
_____

22.0: i) **Does the community have influence on its development agenda?**

Yes [ ] No [ ]

ii) If yes, explain

_____
_____
_____
_____

23.0: **How is the increased water availability impacting on the family unit**

Aspect	Check
Health	
Cleanliness	
Leisure	
Children school absenteeism	
Children school punctuality	
Cooking at the right time	

24.0: **How is the increase in availability of water impacting on the following social aspects**

Aspect	Impact
Security	
Pregnancy rates	
Community cohesiveness (micro/macro levels)	
Marriages	

25.0 **Was trekking long distances in such of water by girls regarded as good or bad?**

Good [ ] Bad [ ]

Explain your answer and the impact of IWSS on the same?

_____
_____
_____
_____

26.0: How frequently were you participating in social functions before and after the IWSS project?

Function	Frequency Before	Frequency After
Religious		
Market days		
Funerals		
Mwethya		
Parties		
Harambees		
Visiting friends		

27.0: How many hours were you spending on sleep at home before and after the IWSS project?

Before the Project		After the Project	
Wet seasons	Dry seasons	Wet seasons	Dry seasons

28.0: Before participating in this project (building structure), whom did you consult?

Person	Check (✓)
Husband (In the household)	
Husband elsewhere	
Wife (In the household)	
Wife elsewhere	
Friends	
Local administration (Headman/Ass.chief/Chief)	
Religious leaders	
Other (Specify)	

29.0: What are the factors working for (promotes) or against community co-operation?- Rank them

Working for	Working against

30.0: List the economic activities before/after the sand dams project and their ranking?

Activity	Before IWSS (Rank)	After IWSS (Rank)
Agriculture		
Livestock		
Bee-keeping		
Vegetable growing		
Brick making		
Tree Nurseries		

31.0: What local factors influence the degree to which the IWSS benefits evolve? (Geographic; cultural; gender; economic; social; etc.)

Promoting	Rank	Limiting	Rank

32.0: What are the notable activities sparked off by the IWSS?

Activities	Contribution to family income (annually in KShs)

33.0: Other indirect benefits accruing to the community alongside the improved water supply system?

Benefits	Check (✓) How
Increased land value	
Fatter livestock	

34.0: i) Have these benefits served as incentives for people living outside the project area to buy or lease land to harness these benefits?

Yes [ ] No [ ]

ii) If Yes explain.

_____
_____
_____
_____

35.0: Are there some negative social and economic attributes (economic costs) resulting from the improved water supply system?

Yes [ ] No [ ]

If yes explain:

_____
_____
_____
_____

36.0: How is the time saved from walking long distances in search of water used?

Activities	Contribution to family income (annually in KShs)

37.0: Time budget:

Typical day in dry/wet season (% time allocation) before and after the IWSS

Before IWSS				After IWSS			
Dry season		Wet season		Dry season		Wet season	
Activity	Time	Activity	Time	Activity	Time	Activity	Time

38.0: What is/was the relative cost of paying somebody else to collect water on your behalf?

Before IWSS		After IWSS	
Dry season	Wet season	Dry season	Wet season
KShs.	KShs.	KShs.	KShs.

39.0: Is the use of the IWSS controlled and planned to avoid negative consequences to the society? (e.g. Unequal access; unauthorised use; overuse; environmental degradation around the water points; water contamination; conflict between water users).

Yes [ ] No [ ]

Explain your answer:

_____
_____
_____
_____

40.0: What are the institutional and social implications of IWSS?:

(Whether user groups and their rights are defined and agreed upon; operation and maintenance organised; and financing policy for users put in place).

_____
_____
_____
_____

41.0: What services/goods are considered necessary for survival in the family?

Before the IWSS		After the IWSS	
Good/Service	Value	Good/Service	Value

42.0: Who controls the household's income and labour; and who decides the expenditure?
Check

	Before IWSS			After IWSS		
	Income	Labour	Expenditure	Income	Labour	Expenditure
Husband						
Wife						
Husband/Wife						
Boys						
Girls						
Mother-in-law						
Father-in-law						
Other (specify)						

43.0: What is the impact of increased family income on the family unit?

_____
_____
_____
_____

44.0: Has the increased income/opportunities led to conflict at?

i) Family level Yes [ ] No [ ]

ii) Community level Yes [ ] No [ ]

If yes in (i) explain:
If yes in (ii) explain:

_____
_____

45.0: If you never participated in the sand dams project, what are the laid down conditions for joining?

_____
_____
_____

46.0: What value do household attach to their sources of water?
Suppose your main water source was to be demolished and you're asked to move to the next nearest source of water, what is the minimum amount of money you would accept as compensation for the loss of the old source?

KShs.	

47.0: Willingness to pay for IWSS
Suppose a certain development partner was to provide IWSS within 2 Kilometres from your household, what is the maximum amount of money would you be willing to pay towards this project?

KShs.	

48.0: Willingness to manage water source.
a) Suppose you perceive that something is wrong with the management of your water source, what measure would you take as an individual?

_____
_____

b) Suppose your elected/appointed to take up a leadership position in the water management committee, would you be willing to up the position?

_____
_____

49.0: What is SASOL's role in the whole sand dams project (Describe)

_____
_____

50.0: Any other comments?

_____
_____
_____

Appendix IV: TABLES OF DATA USED IN THE ANALYSIS

Table 1: Household Composition

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Females=Males	23	18	21	8	24	21	27
Female more than males	42	41	41	44	38	31	35
Females less than males	35	41	38	48	38	48	37
Total	100	100	100	100	100	100	100

Table 2: Head of the Households' Sex

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Female	57	57	57	65	48	56	44
Male	43	43	43	35	52	44	56

Table 3: Heads of Household Age Bracket

Classes	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
20 years and below	3	0	0	0	0	3	1
21-35 years	30	23	26	32	10	31	32
36-55 Years	49	44	46	40	48	52	46
56-70 Years	15	29	28	20	38	12	17
Over 70 years	3	4	0	8	4	2	4

Table 4: Highest Level of Education Attained By Household Head

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Informal	29	29	36	16	36	23	31
Primary	48	46	51	44	44	57	53
Secondary	18	22	10	36	20	17	14
Tertiary	5	2	3	4	0	3	2

Table 5: Main Land Use

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Agriculture	80	85	74	84	82	64	58
Livestock	15	7	18	8	18	27	41
Homestead	3	7	5	4	0	9	1
Other	2	1	3	4	0	0	0
Total	100	100	100	100	100	100	100

Table 6: Head Of Households' Main Occupation

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Farmer	80	89	92	76	98	78	77
Regular employment	3	2	0	4	2	10	7
Business	7	4	5	8	0	3	8
Wage earner	6	5	3	12	0	7	6
Other	4	0	0	0	0	2	2

Table 7: Households' Main Source Of Income

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Crop farming	55	56	69	48	50	59	56
Regular employment	10	14	10	16	16	17	16
Wage earner	12	10	6	14	10	13	15
Business	10	13	10	10	18	10	11
Livestock	4	6	5	8	6	1	2
Other	9	1	0	4	0	0	0

Table 8: Households' Annual Income In The Catchment Areas

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
10,000 ≥ income	26	25	10	32	14	33	39
10,000 < income ≤ 30,000	33	36	67	32	54	27	30
30,000 < income ≤ 50,000	20	16	10	20	12	20	20
50,000 < income ≤ 100,000	18	14	5	12	16	18	10
100,000 < income	3	8	8	4	4	2	1
Total	100	100	100	100	100	100	100

Table 9: Animal Rearing

Number of birds/animals	Wii Catchment			Kiindu Catchment			Ithumula Catchment		
	Chicken	Cows	Goats	Chicken	Cows	Goats	Chicken	Cows	Goats
Nil	8	40	36	10	32	16	5	46	33
1	24	0	0	4	38	42	10	0	0
1 < number ≤ 5	36	52	44	26	24	24	30	38	35
5 < number ≤ 10	24	4	16	26	0	0	28	12	25
10 < number	8	4	4	30	0	16	23	2	5
Not reported	0	0	0	4	6	2	2	0	0
Total	100	100	100	100	100	100	100	100	100

Table 10: Control Of Family Income, Labour And Expenditure

Person/s	Yatta			Mutomo			Wii			Kiindu			Ithumula		
	E	Y	L	E	Y	L	E	Y	L	E	Y	L	E	Y	L
Husband/Wife [A]	55	39	50	45	35	45	12	20	20	32	28	30	49	39	41
Husband [B]	22	41	22	37	50	37	44	48	40	26	38	26	33	43	41
Wife [C]	19	15	24	13	9	13	40	32	36	40	34	44	18	18	18
Other [D]	4	5	4	5	6	5	4	0	4	2	0	0	0	0	0
Husband/Wife or Husband alone [E]	77	80	72	82	85	82	56	68	60	58	66	56	82	82	82
Husband/Wife or Wife alone [F]	74	54	74	58	44	58	52	52	56	72	62	74	67	67	59
Household head [G]	Female: 56 Male: 44			Female: 44 Male: 56			Female: 65 Male: 35			Female: 48 Male: 52			Female: 57 Male: 43		

Key: E= Expenditure, Y= Income, L=Labour

Table 11: Household Farm Implements

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Nil	0	1	3	0	0	6	5
1-5	63	60	57	34	90	50	52
6-10	30	36	40	58	10	42	40
More than 10	7	3	0	8	0	2	3
Total	100	100	100	100	100	100	100

Table 12: Other Household Possessions

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Carts/Wheelbarrows	24	30	18	32	40	21	19
Bicycles	42	38	28	28	58	47	51
Plant Machines	10	8	15	4	5	2	6
Motor Vehicles	4	7	3	8	0	1	2
Televisions/Radios	7	15	5	16	26	4	2

Table 13: Wall Material

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Brick and Mud	50	54	59	59	44	69	67
Brick and cement	46	41	36	36	52	19	27
Block and cement	1	1	0	0	4	1	2
Poll and Mud	3	3	5	5	0	5	2
Other	0	0	0	0	0	6	2
Total	100	100	100	100	100	100	100

Table 14: Floor Quality

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Cemented	38	40	23	10	42	15	11
Uncemented	62	60	77	90	58	85	89
Other	0	0	0	0	0	0	0
Total	100	100	100	100	100	100	100

Table 15: Quality of Thatch

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Iron Sheets	77	85	64	96	84	54	61
Grass	23	15	36	4	16	46	38
Tiles	1	0	0	0	0	0	1
Total	100	100	100	100	100	100	100

Table 16: Energy Sources

	Yatta		Mutomo		Wii		Kiindu		Ithumula	
	First	Second	First	Second	First	Second	First	Second	First	Second
Firewood	98	0	99	0	92	4.0	100	0	97	3
Charcoal	2	19	1	6	4	16.0	0	22	0	13
Kerosene	0	67	0	87	4	64.0	0	74	3	82

Table 17: Nature Of Migration

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Temporary	7	2	5	2	2	12	6
Permanent	10	7	10	4	12	5	14
Working outside	9	9	13	8	14	7	6
Total	16	18	28	16	28	24	26

Table 18: View Towards Necessities Life (Participants And Non-Participants)

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas		Ranking
			Ithumula	Wii	Kiindu	Yatta	Mutomo	
Food	95	96	97	92	100	68	93	1
Water	75	80	85	76	96	79	88	2
Clothing	43	22	21	12	34	24	32	3
Shelter	15	25	26	16	32	29	23	4
Money	14	27	31	20	32	1	13	5
Land	4	28	23	12	50	8	12	5
Fuel	21	27	33	0	48	3	5	5
Education	28	16	0	4	44	1	21	6
Medical care	26	10	18	12	0	19	25	6
Clean environment	2	9	8	8	10	0	1	7
Transport	0	0	0	0	0	24	8	8
Livestock	0	0	0	0	0	19	12	8

Table 19: Water Sources

Main sources of water	Baseline Area				Catchment Area					
	Yatta		Mutomo		Kiindu		Ithumula		Wii	
	D	*W*	*D*	*W*	*D*	*W*	*D*	*W*	*D*	*W*
River	68	53	13	6	0	4	8	8	0	16
Scoop holes	12	4	46	17	4	4	3	0	32	0
Wells	12	6	10	6	14	16	31	33	4	16
Boreholes	3	2	4	0	0	0	0	3	0	0
Earth dam	3	10	12	21	0	0	0	0	0	0
Springs	3	4	2	5	0	0	0	7	0	0
Roof catchment	0	20	0	10	2	14	0	3	0	12
Rock Catchment	0	0	12	31	0	0	0	3	0	0
Sand dams	0	0	2	2	68	62	56	28	60	56
Piped	0	0	0	0	0	0	3	4	4	0

Key: - D: Dry season; W: Wet season

Table 20: Water Fetching Responsibility

	Non-participants (Global)	Participants (Global)	Catchment Areas			Baseline Areas	
			Ithumula	Wii	Kiindu	Yatta	Mutomo
Husband/Boys	4	6	3	4	7	11	11
Wife/Girls	50	49	72	74	77	65	63
Wife/Boys	13	12	23	10	9	11	11
Other	33	33	5	14	7	13	14

Table 21: Factors Considered When Making Choice Of A Water Source

Sub-Location/Catchment	Rank 1	Rank 2	Rank 3
Ithumula catchment	Distance	Quality	Quantity
Kiindu catchment	Distance	No alternative	Quality
Kisiio catchment	Distance	Quantity	Reliability
Wii Catchment	Distance	Quantity	Quality
Mwiiwe catchment	Distance	Quantity	Reliability
Nzangathi s/location	Distance	Reliability	No alternative
Kyangunga s/location	Distance	Quantity	Quality
Wii s/location	Distance	Quantity	Multiple use
Kyanika s/location	Distance	Quality	No alternative
Ithumula/Maluma s/location	Distance	Quality	Quantity
Ngangani s/location	Distance	Quality	Quantity
Masimbini s/location	Distance	Quality	Reliability
Kitungati s/location	Quality	Distance	Quantity
Ngiluni s/location	Distance	Quantity	Reliability
Yatta Division	Distance	Quantity	Quality
Mutomo Division	Distance	No alternative	Quantity
Female	Distance	Quantity	No alternative
Male	Distance	Quality	Quantity
Summary (High frequencies)	Distance	Quantity	Reliability

Table 22: Means of Transporting Water After the Project

	Participants (Global)	Catchment Areas			Baseline Areas	
		Ithumula	Wii	Kiindu	Yatta	Mutomo
Donkey	26	8	48	22	85	67
Human and Donkeys	11	8	8	16	5	22
Human labour	60	84	36	60	7	5

Table 23: Quantity of Water Used

Litres	Baseline Area				Catchment Area					
	Yatta		Mutomo		Ithumula		Wii		Kiindu	
	D	*W*	*D*	*W*	*D*	*W*	*D*	*W*	*D*	*W*
40 and below	18	16	22	17	15	5	4	40	4	2
Over 40-60	13	15	13	16	26	26	4	20	8	4
Over 60-80	29	31	37	31	15	23	28	16	20	4
Over 80-100	13	13	5	6	21	23	32	44	18	32
Over 100	27	25	22	30	23	23	32	16	50	58

Key: D= Dry season, W= Wet season

Table 24: Distance To Main Water Source (Km)

	Ithumula Catchment				Kiindu catchment				Ithumula catchment			
	Before IWSS		*After IWSS*		*Before IWSS*		*After IWSS*		*Before IWSS*		*After IWSS*	
Distance (KM)	D	W	D	W	D	W	D	W	D	W	D	W
Below 0.5	39	71	47	68	10	22	50	42	44	69	69	80
Over 0.5 and below 2	34	21	49	22	34	46	46	42	41	26	31	21
Over 2 and below 5	18	3	4	1	34	16	4	4	10	0	0	0
Over 5 and below 10	7	1	1	1	20	2	0	0	5	0	0	0
Over 10 and below 15	1	0	0	0	2	0	0	0	0	0	0	0
Over 15	2	0	0	0	0	0	0	0	0	0	0	0
not reported	0	4	0	8	0	14	0	12	0	5	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100

Key: D= Dry season; W= Wet season

Table 25: Time Taken To And From The Main Water Source (Hours)

	Global participants data				Wii catchment				Kiindu catchment				Ithumula catchment			
	Before IWSS		*After IWSS*		*Before IWSS*		*After IWSS*		*Before IWSS*		*After IWSS*		*Before IWSS*		*After IWSS*	
Hours	D	W	D	W	D	W	D	W	D	W	D	W	D	W	D	W
Less that 0.5	33	44	51	53	45	78	72	77	26	62	84	72	28	56	69	69
Above 0.5 and below 1	48	40	39	34	20	10	21	8	16	6	12	12	39	33	23	26
Above 1 and below 2	12	12	9	11	15	3	4.5	1	34	10	4	4	15	3	3	5
Above 2 and below 5	5	2	0	0	15	2	1.9	1	22	8	0	0	8	3	5	0
Above 5 and below 10	0	0	0	0	0	1	0	0	2	0	0	0	10	0	0	0
Above 10	2	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0
not reported	0	2	0	0	0	7	0	12	0	14	0	12	0	5	0	0
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100

Key: D= Dry season; W= Wet season

Table 26: Depth of Scoop-Holes

Depth in feet	Wii catchment		Kiindu catchment		Ithumula catchment		Females		Males		Mutomo	Yatta
	D1	D2	D1	D2	D1	D2	D1	D2	D1	D2		
Below 2 depth	12	68	4	88	5	51	12	57	11	59	8	18
Above 2 and below 5	28	16	34	10	33	18	37	15	43	15	31	35
Above 5 and below 10	40	4	48	2	46	3	29	2	25	3	13	5
Above 10 and below 15	4	0	8	0	0	0	5	0	6	1	12	42
Over 15	0	0	6	0	0	0	2	0	2	2	26	0
Not applicable/reported	16	12	0	0	16	28	15	26	13	20	10	0
Total	100	100	100	100	100	100	100	100	100	100	100	100

D1=Before the sand dam project; D2= After the sand dam project

Table 27: Quality Of Water From The Main Water Source

	Kiindu				Wii				Ithumula/Maluma			
Quality	*Before IWSS*		*After IWSS*		*Before IWSS*		*After IWSS*		*Before IWSS*		*After IWSS*	
	D	W	D	W	D	W	D	W	D	W	D	W
Clean/clear/good	65	72	76	69	72	72	80	92	79	86	84	89
Dirty/coloured/bad smell	32	20	23	20	28	24	20	4	7	11	3	7
Salty	0	4	0	0	0	4	0	4	9	1	10	1
Other	2	2	0	2	0	0	0	0	0	0	0	3
Not reported	0	0	0	7	0	0	0	0	3	1	1	1
Total	100	100	100	100	100	100	100	100	100	100	100	100

Key: NP= Non-participants; P= Participants; D= Dry season; W= Wet season

Table 28: Satisfaction Levels

Sub-Location/Catchment	Satisfied (%)	Shifted (%)
Ithumula catchment	87	72
Kiindu catchment	90	78
Kisiio catchment	84	87
Mwiiwe catchment	86	82
Nzangathi s/location	77	31
Kyangunga s/location	74	50
Wii s/location	88	48
Kyanika s/location	55	33
Ithumula/Maluma s/location	89	64
Ngangani s/location	57	56
Masimbini s/location	45	50
Ngiluni s/location	83	67

Table 29: Economic Activities Before And After The Project

Economic Activity	Yatta	Mutomo	Ithumula		Wii		Kiindu	
			Before	*After*	*Before*	*After*	*Before*	*After*
Agriculture	96	79	87	78	92	80.0	98	98
Goat and sheep keeping	73	12	33	31	56	56	22	30
Cattle keeping	16	45	21	28	32	28	10	12
Vegetable growing	5	4	23	44	16	40	8	22
Kitchen gardening	9	3	13	15	8	20	8	10
Brick making	4	7	3	13	32	24	4	8
Tree Nurseries	4	2	21	23	0	12	20	32
Bee Keeping	13	15	15	18	4	12	6	6

Table 30: Impact of Increased Family Income to Family Unit

Type of Impact	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
Positive	71	64	68	82
Negative	10	11	16	2
The same	4	10	0	2
Not reported	15	15	16	14
Total	100	100	100	100

Table 31: New Crops And Activities

	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
Spinach growing	10	15	8	6
Fishing	11	13	4	16
Sukuma wiki	44	60	64	6
Onions	6	5	8	6
Tomatoes	10	18	12	2
Ndania	4	5	0	8
Sugar cane	5	8	8	0
Arrow roots	1	0	0	4
Fruits	6	8	4	6
Other crop	5	5	4	7

Table 32: Cost of Water Per 20-Litre Jerrican

Ksh.	Baseline Area		Catchment Area					
			Ithumula		Wii		Kiindu	
	Yatta	Mutomo	Before	After	Before	After	Before	After
5 and below	28	7	26	74	28	40	26	74
Over 5 -10	54	46	54	15	44	32	56	22
Over 10-15	5	15	3	3	0	0	10	0
Over 10-20	6	24	10	8	4	12	6	2
Over 20	5	7	3	0	8	0	2	0

Table 33: Unplanned Benefits

	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
Vegetables- plenty and cheap	20	28	12	22
Increased sand for construction	13	21	4	14
Increased land productivity- increased water and terracing	14	8	12	22
Increased livestock reproduction rates	9	15	8	3
Soil fertility- tree planting and terracing	6	3	4	10
Able to cloth the family- increased income	6	8	8	2
Increased land value	5	10	4	2
Able to pay school fees- increased income	3	3	4	2
Reduced cost of buying salt lick for animals	2	3	4	0

Table 34: Willingness To Pay For Improved Water Supply System

Amount in Ksh	Catchment Areas			Baseline Areas	
	Ithumula	Wii	Kiindu	Yatta	Mutomo
Less than 500	46	32	32	17	50
Over 500-1000	18	20	22	7	14
Over 1000-5000	3	8	28	10	22
Over 5000-10000	13	12	8	5	3
Over 10000	8	20	10	5	3

Table 35: Person Consulted Before Participating In Community Development

Person	Participants (Global)	Catchment Areas			Baseline Areas	
		Ithumula	Wii	Kiindu	Yatta	Mutomo
Husband in the household	17	5	30	16	40	32
Wife in the household	7	12	10	0	17	29
Wife elsewhere	4	0	0	12	3	0
Friends	27	18	30	32	16	7
Local provincial Administration	10	21	10	0	0	11
None	20	21	20	20	0	7

Table 36 (a): Factors Promoting Community Cooperation Among The Participants

Factor	*Promoting*
Hardworking	15
Commitment	14
Listening to others problems	5
Peace	8
Good leadership	12

Table 36 (b): Factors Limiting Community Co-operation Among The Participants

Factor	*Limiting*
Political party affiliation	8
Gossip	8
Lack of respect	6
Poverty	13
Diseases	5
Poor leadership	21
Hatred	22
Illiterate	21
Corruption	14

Table 37: Value Households Attach To Their Water Source

	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
500 ≥ Ksh.	3	0	4.0	4.0
500 < Ksh. ≤ 1,000	3	0	0	8.0
1,000 < Ksh. ≤ 5,000	6	1	16	0
5,000 < Ksh. ≤ 10,000	4	4	8	0
10,000 < Ksh.	5	10	4	0
Not acceptable (invaluable)	69	70	60	78
Not reported	10	15	8	10
Total	100	100	100	100

Table 38: Ownership of Water Sources- Global Data

Who owns the Dam	(%)
Community members	77
Government	18
Some individuals	5
Ruling Party (KANU)	5
Kathambi	5
SASOL	44
Schools	9
Main opposition in the region (SDP)	1
Christians	5

Table 39: Value Households Attach To Their Water Source

	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
500 ≥ Ksh.	3	0	4.0	4.0
500 < Ksh. ≤ 1,000	3	0	0	8.0
1,000 < Ksh. ≤ 5,000	6	1	16	0
5,000 < Ksh. ≤ 10,000	4	4	8	0
10,000 < Ksh.	5	10	4	0
Not acceptable (invaluable)	69	70	60	78
Not reported	10	15	8	10
Total	100	100	100	100

Table 40: Waterborne Disease Mitigation Measures

	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
Boiling	78	69	72	94
Chemicals	4	3	4	4
Clear Bushes	4	3	0	10
Well cooked Food	0	0	0	0
Drying stagnant water	0	0	0	0
Inoculation	1	3	0	0

Table 41: Laid Down Conditions For New Users

	Participants (Global)	Catchment Areas		
		Ithumula	Wii	Kiindu
Below 100	2	5	0	0
100-200	16	31	4	12
201-500	22	33	12	22
501-1000	9	5	8	14
Not fixed	21	8	36	20

Appendix V: POPULATION DYNAMICS IN THE PRESENT KITUI DISTRICT

	1962	1969		1979		1989		1999	
MIGWANI	20,064	CENTRAL	111,853	CENTRAL	157,901	KWA VONZA	116,172	**YATTA**	41,646
Mutonguni	20,064	Mulango	35,492	Mulango	26,998	Matinyani	31,937	Yatta	17,375
CENTRAL	87,868	Matinyani	18,333	Kisasi	22,203	Yatta	14,369	Kwa Vonza	6,157
Kyangwithya	33,254	Kyangwithya	31,814	Matinyani	23,370	Kanyangi	13,551	Kanyangi	18,114
Matinyani	15,277	Nzambani	11,827	Kyangwithya	28,502	B2 Yatta	4,608	**KABATI**	99,736
Mulango	28,299	Yatta	12,253	Miambani	16,807	Mutonguni	51,707	Kauwi	15,602
Nzambani	11,038	Yatta B2	2,134	Nzambani	16,878	CENTRAL	154,344	Kalia	6,648
EASTERN	24,807	EASTERN	20,786	Yatta	19,522	Kyangwithya	41,003	Kithumula	7,392
Endau	4,023	Mutitu	6,408	Yatta B2	4,387	Miambani	22,836	Kathivo	3,732
Mutito	5,039	Endau	6,178	EASTERN	28,533	Mulango	35,697	Usiani	5,292
Yatta	9,021	Zombe	8,200	Mutitu	9,572	Kisasi	30,522	Mutonguni	13,038
Zombe	6,724	SOUTHERN	56,182	Endau	7,985	Nzambani	24,286	Mutulu	5,755
SOUTHERN	44,938	Ikanga/Mutomo	19,841	Zombe	10,976	MUTITU	37,155	Kwa Mutonga	6,870
Ikanga/Mutomo	15,749	Ikutha	13,230	SOUTHERN	73,857	Mutitu	12,857	Kakeani	7,113
Ikutha	10,379	Kanziku	8,988	Ikanga/Mutomo	23,907	Endau	9,958	Kauma	5,497
Kanziko	6,349	Voo	8,398	Ikutha	20,649	Zombe	14,340	Kalimani	4,944
Mutha	4,783	Mutha	5,725	Kanziku	11,497	MUTOMO	104,857	Musengo	10,418
Voo	7,678	NOTHERN	25,585	Voo	10,593	Kanziku	8,793	Katutu	7,435
		Mutonguni	25,585	Mutha	7,211	Mathima	6,307	**CENTRAL**	123,742
				NOTHERN	35,305	Ikanga	22,449	Kyangwithya West	16,907
				Mutonguni	35,305	Mutomo	13,071	Kyangwithya East	30,796
						Voo	13,354	Maliku	10,063
						Mutha	8,401	Township	15,433
						Ikutha	14,869	Mulango	15,564
						Athi	17,590	Katulani	8,293
						Tsavo East	23	Miambani	18,620
								Itoleka	8,066
								CHULUNI	72,341
								Nzambani	23,079
								Nzangathi	7,881
								Mbitini	17,692
								Kisasi	12,118
								Mbusyani	11,571
								MUTITU	23,860
								Mutitu	8,903
								Kaliku	5,494
								Zombe	9,463
								MWITIKA	19,702
								Malalani	5,237

Endau	5,733
Mwitika	8,732
MUTOMO	79,835
Mutha	4,670
Ndakani	5,811
Mathima	7,681
Mutomo	7,857
Kibwea	9,501
Kyatune	11,528
Ikanga	16,901
Voo	9,886
Kyamatu	5,999
IKUTHA	54,560
Kanziku	6,325
Simisi	4,765
Kasaala	6,035
Ikutha	12,112
Maluma	7,118
Kalivu	7,780
Athi	10,414
Tsavo East	11