REHYDRATING THE EARTH IN ARID LANDS (REAL)

Work Package 2 (UoN)Report for the year 2003

DELIVERABLE D4a

WATER USE AND IMPROVEMENT IN HYGIENE

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PROJECT BACKGROUND

Introduction

Soil and water conservation is a high priority in Sub-Saharan Africa, especially in the drier areas. Storage of water from the rainy season to the dry season or even from wet years to dry years is highly important. Surface reservoir storage has drawbacks, such as high evaporation rates, contamination danger and taking valuable land out of production. Using the sub-surface to store water is another option. Through the application of ground water dams, which obstruct the flow of groundwater and store water below the ground surface, existing aquifers can be replete or new, shallow aquifers can be created. Many projects and policies have been implemented to improve the condition of land and water in the areas, but much failed because they did not recognise the location specificity of conservation problems and solutions in Sub-Saharan Africa and in applicability of imported methods without adaptation. In response to this failure, approaches that do try to take into account local conditions (material and immaterial) have come to the front, but in general these approaches have been limited to the level of individual farms (focusing on cultivation), using communities as medium for exchange or theoretical level, giving ample debates on how to do it without actual results in the field.

The general objective of the REAL project is to:

> Clarify the relations between local practices and theoretical approaches, by focusing on the design, management and performance of small groundwater retaining structures on a communal level in semi-arid regions in the two African countries, Kenya and Tanzania, linking both the individuals and community as well as theory and practice, resulting in guidelines for participatory design of small water retaining structures in semi-arid regions worldwide.

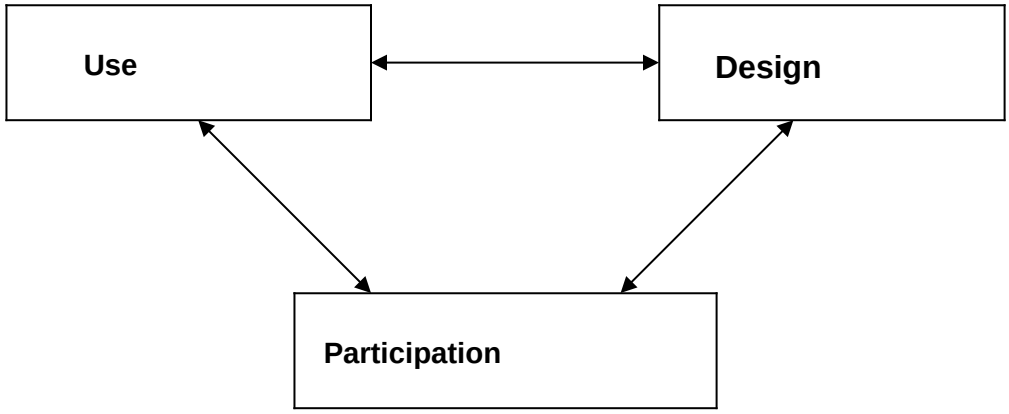
The project will investigate the different parameters of success of the Kenyan systems, with respect to technological possibilities sustained by social, economic, organizational and managerial factors of the communities and local government. The outcome is tested parallel in other Kenyan and Tanzanian areas. Results in all areas will lead to the production of a manual for design, operation and maintenance of small water retaining structures, with focus on local management and community participation. Attention points for spin off and diffusion, applicable to semi-arid areas to stimulate implementation on wider scale.

Specific Scientific and Technological objectives

(1) Clarification and further implementation of the participatory design, construction and management approach for small water retaining structures in research areas;
(2) Clarification of the performance of small water retaining structures including aspects concerning hydraulics, hydrology, water use and health;

(3) Development of a system perspective on design, management and performance of small water retaining structures in semi-arid areas;
(4) Development of participatory design approach applicable in other regions for comparable small water structures;
(5) Education and training of staff, students and local communities through exchanges in workshops, field visits, formal education and networks;
(6) Dissemination of the project results through a manual (Scientific Book) a number of Scientific papers and conference proceedings.

The set-up of the REAL project is concentrated on the interrelationship between water use (including non-human use) design of structures and community participation as depicted below



The project is executed through four work packages, each focusing on a particular aspect of the above triangle.

- Work package 1 integrates the findings and develops the methodology;
- Work package 2 focuses on water and participation; and its consequences for design. It provides for work WP2 and 4
- Work package 3 focuses on the effects of dams and ways to consider that in new designs. It provides input for WP4.
- Work package 4 provides the test case in which all aspects mentioned are taken into account.

Work package II is using a participatory research design on water use and quality evaluation and management. The project used a case study approach in three communities that represent the various conditions in the area. (Testing of water quality at various points from source to cup and in a sufficiently large sample to warrant conclusions.) The assessment of management and water use patterns was done through a participatory study. Gender issues are considered as central variables to the study. Existing categories of user groups were selected to participate in the research.

Specific Goals; Work Package2

1) To assess the quality of the water at all points from source to cup.
2) To investigate the water handling and source management practices for domestic and agricultural use and relate these to the water quality conditions found through testing
3) To determine any improvements achieved in comparison with previous conditions of management and use.

STUDY OBJECTIVES

The general objective of the study (by work package 2) was to generate information leading to enhanced knowledge of the water sources and their management with a view to draw conclusions on progress achieved in the construction of sand dams and identify possible areas for further development. The specific objectives were

- To evaluate the management and use of the existing sand dams
- To give recommendations for future design and management of the sand dams.

In accomplishing these tasks, the following pertinent aspects have been considered:

- Management of the dams
- Safe use of the water
- Experiences of women, men, poor, rich and in-between, with respect to quality, quantity, reliability, accessibility and control *of water source*.
- The economic purposes for which the water gains are used.

METHODOLOGY

METHODOLOGY FOR PARTICIPATORY ASSESSMENT (MPA)

This study utilized the MPA methodology (methodology for participatory assessment). This methodology was considered apt since the construction of a sand dam lends it self to participatory methodologies. These are methodologies that are less extractive and promote exchange of information between the researchers and the researched.

The MPA is a methodology to help communities, sector institutions and policy makers achieve more sustainable and equitable services. This methodology employs a scoring system to quantify data from participatory assessments. It is a methodology that is demand, gender and poverty sensitive and thus indicators for these aspects are developed together with a sequence of participatory tools to assess these indicators.

Some of the essential quality aspects of the MPA include

- The involvement of all stake holders
- Mainstreaming of gender, poverty and demand
- Self scoring system
- Visualization of the outcomes of the assessment
- Self analysis and room for action planning for improvement
- Triangulation of the data collected, between the different community members and between the implementing agencies and the community members
- Generation of both quantitative and qualitative information that is useful for all stakeholders.

SITE DESCRIPTION

The study was based in the (old) central division of Kitui district, of the Eastern province of Kenya. The district borders Machakos and Makueni to the west, Mwingi district to the north, Tana river to the east and Taita Taveta to the south. It covers an area of approximately 20555.74 km^2 including 6369.1 km^2 occupied by the uninhabited Tsavo national park.

The study area is located in the central part of the district, herein referred to as Kitui central division. Kitui central encompasses the following locations: Kyangwithya west, Kyangwithya east, Maliku, Town ship, Mulango, Katulani, Miambani and Itoleka, which have a total population of 123,742 (CBS, 2000). The population density of Kitui central is 153 persons per square kilometer.

Kitui central is classified as a medium agro-ecological zone. The average annual rainfall is 760-1015 mm. It should be noted that such figures mean very little as there are wide fluctuations from year to year. This division experiences two main seasons; the long rains in April to May and the short rains from November to December. The dry periods are

from June to October and January to March. It is common for rains to fail in one or both seasons leading to prolonged periods of drought and food shortage. Local lore states that rains fail completely at least one year in four (SASOL and Maji na Ufanisi, 1999).

Water, being the major development input remains the essential commodity in the entire area, thus water searching has become a significant preoccupation of every one since there are few natural water resources. Available sources dry up during prolonged drought thereby causing a lot of suffering to both human and livestock leading to stress on the environment.

The lack of water is thus a persistent problem. The climate is hot and dry for most parts of the year and is characterized by high rates of evaporation. A combination of high evaporation rates and unreliable rainfall limits intensive and meaningful land use and other related development activities.

SASOL, the development agency in the area, has constructed over 300 sand dams in the Kitui central in a bid to solve the water problem and as a response to the impact of drought in the area.

SAMPLING

In a number of REAL meetings, three communities had been selected for study in year 1 of the project. These are Tungutu , Ithumula/ Maluma, and Nzangathi. These areas are basically sub-locations.

In each of these three sub-locations, 11 sand dam committees were selected for the study. This selection was guided by the topographical maps of SASOL showing the location of sand dams. In each catchment 11 sand dams were selected for observation. Three categories of sand dams were selected for the study; the newly constructed, those in the filling stage and the mature dams. The dams in Tungutu Sub-location are in the initial stage, those in Ithumula/Maluma are in the filling stage while those in Nzangathi Sub-location are mature.

For the in-depth studies, local definition of a community was followed to curve out a *community* for study. Since SASOL employs the catchment approach, the definition of a community included aspects such as; sharing a common water source(s), have common community problems and engage in social activities together. Such activities include; common welfare associations, funerals, marriages and live in one catchment or one small geographical locality. In brief, the locals take a community to be a social entity that cannot be limited to administrative and political boundaries. The communities chosen for the in-depth studies are Ithookwe/Mathunzini in Tungutu sub-location, Mbiuni in Ithumula Maluma sub-locaton, and Mumbuni –Ngomango in Nzangathi sub-location.

DATA COLLECTION EXERCISE

The data collection period was 2 months, May and June 2003. This was conducted by four researchers from the University of Nairobi. The researchers were paired into two, male and female. Such pairing was seen as necessary to ease communication with the sand dam committee members, who are both male and female. These teams worked under close supervision by the supervisor and the senior researcher.

The teams visited the sand dam committee members on site and initiated discussions with them. These discussions were guided by the scoring sheets and not necessarily limited to them. Additional qualitative information was also collected and recorded in note books. To facilitate exchange of information and guard against extraction, the researchers also educated the committees on certain salient aspects related to use of sand dams. This was also the case during the community workshops. Specifically, during the sand dam visits, one researcher acted as a moderator while the other was the scorer. Home visits were made to homes in each of the selected catchments to make observations on water handling and invite people for the workshop. During the community workshops, the four researchers worked as a team switching roles as necessitated by the situation. Each workshop took three days.

DATA PRESENTATION AND ANALYSIS

After data collection, information gathered was subjected to clerical editing to ensure that each and every aspect was correctly scored. Much of this clerical editing was done in the field while the information was still fresh in the researcher's mind.

The second stage involved preparation of a code book, coding of scoring sheets (*questionnaires)*, and data entry. The data was analyzed using the statistical package for social scientists (SPSS-pc). This package produced descriptive statistics that were used in the presentation and analysis of the information. The quantitative information gathered was highly complemented with qualitative information.

WATER USE AND IMPROVEMENT IN HYGIENE

Conceptually, improvement in water supply is expected to lead to improvement in hygiene. During the process of dam construction, community members are trained on safe water source management and use. The following was established in relation to the training offered to the community.

TRAINING

SASOL has a policy of training community members who actively participate in the construction of sand dams. This training is done at three levels. Through participatory rural appraisal (PRA) method the community members identify the problems facing them, analyze, prioritize and come up with possible solutions. They identify the resources which are required for solving various problems listing the locally available materials and what is required from external sources. This activity is undertaken during a community *baraza* which is open to all community members.

During the construction phase, community members are trained on community leadership and organization after which they are required to form site committees. During the study it was established that the community was trained on natural resource management, community leadership, and sand dam maintenance in 19.4 % of the sites set for the study (table 1).

Table 1: Distribution of respondents by type of training received

Type of training	Frequency	Percentage (%)
None	20	55.6
Natural resource management	2	5.6
Community leadership	3	8.3
Sand dam maintenance	2	5.6
Natural resource management/ Community leadership Sand dam maintenance.	7	19.4
Other(food security, horticulture)	2	5.6
Total	**36**	**100%**

Table 1 shows that in 44.4% of the sand dams, there was an aspect of training. In 36.1% of the cases, the training was conducted by the project agency alone while in 8.3 % of the cases, training was done by different development partners either individually or in partnership. Such development partners included the project agency, ministries of Health, Agriculture, and Livestock development. The higher percentage of cases where there was no training is explained by various reasons. First, majority of the dams (47.2%) were constructed in the year 2000 to 2001 especially in Kamale (in Ithumula/Maluma sub-location) and Tungutu areas concurrently. This strained the human resource base of the agency leaving a skeleton staff to conduct trainings. Secondly, the time schedule for dam construction was so squeezed that not many people could be released from the construction work to attend training. Lastly, the response to this question needs to be treated with caution since the people's perception of training was where they had been called in a seminar or workshop setting. Thus in cases where training was done in barazas, such was not construed as training. This explains why a large majority of respondents reported cases of not having been trained. It was established from the project management that all barazas held during the construction process, are laden with training aspects.

When the process of construction is on, SASOL organizes for a community training seminar whereby each sand dam community is required to send a given number of representatives to the seminar. The members are drawn at the level of sub-location because it brings people from the same locality who shares common interests and problems. The seminar covers community leadership and organization, natural resource management and hygiene and sanitation. The trainees are supposed to share the imparted knowledge with other members of the community. The training carried out in the project area covered hygiene, sanitation, food management, natural resource management and project management and leadership.

Information on training is passed on to the community either through the local leaders, administration, or sand dam committees. In other instances, the project staff play a key role in passing this information. Research findings show that according to both gender (47.2%), a general announcement was made and there was repeated special efforts to inform the poor. Thus everyone in the community was aware of the training. Women reported that in 41.7% of the cases, all people were given equal chance to register for training, and there were special provisions for the poor and women to attend. This assertion was echoed by men in 44.4% of the cases who asserted that all were given an equal chance to opt for training (table 2 and 3).

Table 2: Responses of men and women regarding information on training

Information on training	**Men**		**Women**	
	Frequency	Percent	Frequency	Percent
No training	15	41.7	14	38.9
Only key people knew about training	4	11.1	5	13.9
General announcement made and all knew	17	47.2	17	47.2
Total	36	100.0	36	100.0

Table3: Responses of men and women regarding opting for training

Option for training	**Women**		**Men**	
	Frequency	Percent	Frequency	Percent
No training opportunities	18	50.0	15	41.7
Training opportunities captured by elites	2	5.6	2	5.6
All got equal chance but no information to allow poor and women	1	2.8	2	5.6
Sufficient information but not easy for poor and women	-	-	1	2.8
Equal chances to all, special provisions for the poor	15	41.7	16	44.4
Total	36	100.0	36	100.0

When the sand dam construction is over, all community members are trained on site sanitation and hygiene. They are trained on the importance of construction of pit latrines,

boiling water and handling of water from the source to the household level. The training also covers environmental protection in the areas near the sand dams and the farms. The members are also advised on the suitable plants for protection of the wall and the riverbanks. These include; nappier grass, reeds and sugarcane. The importance of conserving the trees along the river banks is also stressed. Members are also trained on maintenance of cleanliness in the sand dam area. They are encouraged, for example to have different scoop holes for different uses, not to water livestock on the upper side of the dam, and not to bathe in the dam.

Community members are trained on the importance of soil conservation on the farms through terracing and planting of cover crops. The training also covers planting of fruit trees and other species for wood and construction purposes. Food budgeting is also a constituent part of the training.

During the research, it was established that in majority of the cases (25%) the number of women trainees ranged between one and five people while in 30.6% of the cases male trainees ranged between one and five. Generally the total number of trainees in majority of the dams ranged between one and five. In 13.9 % of the cases, members of the upper class were trained on community management; leadership and organization, while in 39% of the cases members of the middle class were trained. On these aspects, the poor were trained in 22.2% of the sand dams (table 4).

Table 4: Number of trainees by class

No of trainees	**Upper class**		**Middle class**		**lower class**	
	Frequency	percent	Frequency	Percent	Frequency	Percent
None	14	38.9	5	13.9	11	30.6
1---5	4	11.1	9	25.0	4	11.1
6---10	1	2.8	1	2.8	-	-
11---15	-	-	2	5.6	3	8.3
16---20	-	-	1	2.8	-	-
31---35	-	-	1	2.8	-	-
Above 51	-	-	-	-	1	2.8
Missing cases	17	47.2	17	47.2	17	47.2
Total	**36**	**100.0**	**36**	**100.0**	**36**	**100.0**

Regarding health and hygiene, in 41.7% of the dams there was training on sanitation, water handling, boiling and the importance of latrines. The others (58.3%) claimed that they had not been trained on these aspects. In 27.8 % of the cases, training on health and hygiene was conducted by the project agency, while in 13.9% of the cases training was conducted by different development partners including other NGOs and government ministries.

The numbers of trainees in hygiene and sanitation does not differ significantly with that of those trained in community leadership and organisation. However, in terms of class,

36.1% of the cases had middle class trainees while the lower class trainees were in 27.8% of the sand dams. The upper -class were only trained in a mere 19.5 % of the cases.

There was also significant imbalance in terms of gender. For instance, in management and leadership, it was reported that in 66.6% of cases where training took place, there was unequal gender balance. Similarly, in 60% of the cases trained in health and hygiene, there was no gender balance. In training for management and leadership, gender balance was reported in only 20% of the cases while in health and hygiene, gender balance was reported in 33.3 % of the cases trained. Training in natural resource management took place in 16.7 % of the total sample. Of these, there was no gender balance in 66.5 % of the cases.

The foregoing discussion shows that women participated more in the training sessions than men. Further, the middle class dominated the training in terms of numbers. The explanation for the higher number of women in training is that, they are the majority in the rural areas since most men have migrated to urban areas in search of employment. In development literature, the middle class have been singled out as movers of development in rural areas. The findings of this study are in agreement with this assertion. It should be noted that of those trained (41.7%) all classes were trained in 40.04% according to women and in 46.5 % according to men. Thus there is a fairly moderate social equity in training received. Since those trained act as trainers of communities, this implies that the information gained in training is fairly passed on to the entire community. This can be improved with ease. Table 5 presents information on the effective use of training received.

Table 5; Distribution of respondents by effectiveness in use of training

Use of training	**Women**	**men**
Training received not being used	5.0%	4.6%
Training used by few but some are good at it	30.0%	31.8%
Training used by most and most are good at it.	25.0%	27.3%
Training is being used by all and well	40.0%	36.3%
Total	**100%**	**100%**

In agreement with the earlier discussion, table 7 shows that in majority of the cases (40% as reported by women and 36.3% as reported by men), training received is being used by all and well. In deed, training is being used in 95% of the cases as reported by women and in 95.4 % as reported by men. The percentage failure of use of training received is meagre and can easily be dealt with. In any case, it is fallacious to expect perfect adherence to information pertaining to development in an ordinary community and within a short span of time.

Use of Existing Sand Dams

The basic objective of SASOL is to provide water to communities in ASALS for domestic and production purposes. The planning objective was to provide water to a distance of less than two kilometers from home. Field data shows that sand dam water is

used for domestic and agricultural purposes but in varying degree as shown in table 6 below.

Table 6: Water use

Water use	Frequency	Percentage
Watering cattle	36	100.0
Washing clothes	35	97.2
Bathing	35	97.2
Construction	34	94.4
Brick making	33	91.7
Tree nurseries	28	77.8
Irrigation	24	66.7
Drinking	22	61.1
Beer brewing	21	58.3
Bee keeping	18	50.0
Fish breeding	16	44.4
Swimming	13	36.1

Table 6 shows that the sand dam water is mainly used for watering cattle (100.0%), washing clothes (97.2%), bathing (97.2%), construction (94.4%) and brick making (91.7%). These are uses that do not strictly require safe water. The relatively lower use of the sand dam water for drinking (61.1%) is explained by the fact that majority of the sand dams (55.6%) are in the filling stage and have stagnant water, which is only safe for other purposes other than drinking. Scoop-holes for human use are only in 55.6% of the sand dams. Further, most of the sand dams (86.1%) do not have operational off-take wells. In other instances some few people have alternative sources of drinking water which include water tanks and piped water (only in Tungutu). Several others have dug their own wells near the rejuvenated rivers. [Sinking of off-take wells is still going on].

It should be noted that the sand dam project has been able to meet the peoples' need for drinking water in 61.1% of the cases. Before then, this was the population that had severe shortage of safe drinking water. The fact that in 100% of the cases people used the sand dam water for their livestock is a sure pointer to the acuteness of the water problem that existed prior to the initiation of the project.

Reliability, Quantity and quality of the Sand Dam Water

Majority of the dams in Kitui (55.6%) are in the filing up stage. Mature dams constituted only 22.2% of the study sample. Some 13.9% of the dams had just been constructed. Mature dams with a water lifting device constituted a small percentage of 8.3%. This implies that reliability of the sand dam water is dependent on the purpose for which the water is needed. Thus, in majority of the cases, the dams provide adequate water for livestock, construction, irrigation, and brick making. It was reported that 33.3% of the dams have stagnant water for 10 months in a year. Some 22.2% of the dams have water between 1—9 months in a year. This means that there is adequate water for the above purposes through out the year in a majority of the dams. In 63.9% of the cases, dams have water, either stagnant or in the sand for more than 10 month. In cases where there is no

off-take well, people draw water from scoopholes on the sand. It is only in 13.9% of the cases where it was reported that dams have no water at all. These are the dams that were newly constructed and since their completion, there was no flow of water in the river channel. This also includes the one sand dam that had been washed away (itumba sand dam).

Quantity of water in the sand dam is said to be a function of the size of the reservoir. It has however been demonstrated that the quantity of water in a sand dam is much higher than the calculated volume of the reservoir. This is due mainly to lateral and vertical recharge. Community members reported that there is water in the off take wells even after the water in the sand has dried up. However, 63.6% of the women in Mumbuni-Ngomango community placed the quantity of water between 10 and 20 on a hundred-unit scale on the rope. Men (42.9%) put the figure at 10. In Mbiuni community, 61.1% of the women and 62.5% of the men placed the quantity between 40 and 50. In Ithookwe/ Mathunzini community, 72.4% of the women placed water quantity between 30 and 50 while77.7% of the men placed it at 30 on the same scale.

The above discussion is reminiscent of the fact that water is always available in the sand dams/ off-take wells through out the year since only one person placed the quantity at zero. The quantity is higher in Ithookwe/ Mathunzini and Mbiuni communities than in Mumbuni-Ngomango community.

Water quality is a rather complex issue. To the community, water quality is tied to clearness of the water. The following discussion relates to quality of water during the dry season. In mbiuni community, 59.1% of the women placed the quality at 40 on a hundred unit scale while 38.8% of the men placed it at 50. In ithookwe community, 41.3% of the women placed the quality at 40 while 57.1% of the men put it between 30 and 40. In mumbuni-ngomango, 42.9% of the women rated the quality as between 20 and 30 while 50 % of the men placed it between 30 and 40.

The above discussion shows that quite a significant percentage of the community members are satisfied with the quality of the water in the dry season. Qualitative data reveal that the quality of water is very low during the rain season. This is attributed to the fact that surface run off fills the river channels with soiled water. The materials filling the sand dam also affect the quality of water, particularly, in the scoop holes. This study has not dealt with the issue of quality of water in the scientific sense.

Quality of Materials Filling the Sand Dams

The ultimate goal of construction of a sand dam is to trap sand which is meant to store water in the spaces in between the grains. The process of filling the dam with sand takes time. This depends on a number of factors; the volume of sand transported through the channel, the gradient of the stream, soil conservation in the catchment area and the number of Sand dams in the upper stream. Initially, a sand dam fills with water, silt, leaves, wood, small rocks and pebbles. During the same time other materials like animal droppings, human waste and other material are washed into the stream by surface run-off. These materials are filtered by the water with time and finally the dam is filled with sand.

In 41.7 % of the dams, community members reported 2—3 faults on the quality of the materials filling the dam while in 36.1 % of the cases only one fault was reported. However in 16.7 % of the sand dams, community members were fully satisfied with the quality of the materials. This was the case in the mature dams particularly in Mumbuni-Ngomango community in nzangathi location of chuluni division.

In the mature stage, most dam are colonized by grass and reeds. At this stage the water table has completely stabilized and water can be scooped from the sand. The area on either side of the river banks have either developed into wetlands or shallow wells can be sunk from short depths. Community members reported that the most desired materials filling in the dam are water and sand. The sand stores and cleans the water which filters in to the offtake wells or is scooped from the sand.

Access to Water Sources

It was established that in the three communities, Mbiuni, Mumbuni/Ngomango and Ithookwe/Mathunzini, all the families access water from sources within two kilometers from their homes. Data shows that in the three communities, a mere 11.1% trek for two kilometers from their homes to the nearest water source. Majority (89.9%) of the people access water from sources within a distance of less than a kilometer. Indeed majority of the homes access water from a distance of ½ a kilometer from their homes. The longest distance from a water sources is 2 kilometer while the shortest distance was found to be 50 meters. This is a pointer to the fact that the project has achieved its goal of minimizing distances to water sources in addition to providing water for domestic use and production purposes. This is the way to catalyze development in ASALs.

Due to reduced distances to the water sources, it was found out that community members have increased access to water. As a result, there is increased use of water in the households. Thus, people use more water for washing purposes, cooking, and watering animals. It was established that, unlike in the past when cattle were watered 2-3 times a week, they are now watered on a daily basis. People bath more regularly than before and as a result they perceive themselves as more clean as a result of availability of water. In deed the home environment was said to be cleaner since clothes and utensils are almost always clean.

Water Handling

In Ithookwe community, all people use private or sometimes public kiosks as a source of water for drinking. It was also noted that all households also harvest rain water for drinking while only one household use piped water supply. Only four households use scoop holes at the sand dam for drinking water. In most cases, water for cooking and drinking is obtained from private or public kiosks, private wells and in a few cases, scoop holes at the sand dam, while water for irrigation and fishing is obtained from the sand dam only.

All households water their livestock in the sand dam while a few use the sand dam water for brick making. From the above observation, it can be concluded that the sand dam is the main source of water in Ithookwe but drinking water is mostly obtained from other sources since majority of the sand dams have no off take wells.

In Mbiuni and mumbuni communities, majority of the people use the sand dam water for drinking, cooking, washing, irrigation, watering livestock and fishing. However, a few households use private wells for making bricks. Others have private wells where they draw water for drinking. These are mostly middle class and upper class households. There are some seasonal springs in the area where water for cooking, drinking and washing clothes is sometimes drawn from. Thus unlike in ithookwe, the sand dam is the main source of water in mbiuni and mumbuni. There are indeed more scoopholes in these areas than in any other community visited for the study.

Drawing Water from the Source

As alluded earlier, most sand dams have no off take wells. Thus water is only scooped from the sand using calabashes. The area around the scoop holes is maintained clean and donkeys are tethered away from the scoop holes to minimize contamination. In sand dams where there are off take wells, most people use the rope and bucket method to draw water. However there are no common water lifting devices in these wells since each person has their own rope and bucket. It was said that a permanent device could not be left at the well since it could be stolen. The idea of each person having their own rope and bucket paves way for more pollution. This is because there is a possibility that most of the devices are not clean and hence pollutants are introduced from the different homes. Notably, only two off take wells in the sampled communities had a water pump as at the time of the survey. There were no indications that in such sand dams the water could be polluted.

In the three communities water is commonly transported in jerycans using donkeys. Other times women carry the containers in their backs, while a few people use ox carts and wheel barrows. Little precaution is taken to ensure that the water is not contaminated. The only aspect taken in to consideration is that the containers are tightly closed.

Water Treatment

Boiling water is the commonly used form of water treatment in all the 3 communities. However, most people don't boil water at all. Surprisingly some people boil water sometimes especially when there is amoebic epidemic and water is only boiled for the affected person(s) only. Chlorination is only used in Ithookwe/Mathunzini community by 4 households out of which 3 are from the upper class. This is used all the time. Six households use chlorine sometimes.

Water Storage

All people in the 3 community store water in jerricans and some use bucket with lid and clay pots as alternative facilities for water storage. In Ithookwe, six households from low and middle class households store water in drums without lid.

Majority of the people in the 3 communities draw water for consumption using one cup especially children while adults use two cups for drawing water for consumption. Two households in Ithookwe use water jugs for drawing water.

It was observed that in all 3 communities there is increased water use for domestic, agriculture and livestock. Water is mostly stored in the transporting jerricans, and little is done to treat the water for drinking purposes.

CONCLUSION

SASOL involves the community in the implementation process of the project. A baraza is organised to sensitize and enlighten the community on the potential of the sand dams in alleviating their water problems.

At this point it is the responsibility of the community members to decide whether to buy the idea or not. Upon acceptance the community together with the agency's technical personnel is involved in survey and site identification.

It was also established that majority of the committee members participated actively in monitoring control and decision making during the construction phase. Women were very crucial monitoring and control by ensuring that members contributed the necessary dues. Study findings reveal that monetary contributions were made only during the construction period and the daily contributions ranged from Ksh 5 to Ksh 40.

In almost all sand dams studied (97.2%) rules were set to guide the community during and after the construction phase. However, most rules covered the construction phase and were rendered irreverent after the completion of the sand dams. Data shows that during construction there was a fair trend in the adherence of rules and cases of non-adherence were checked through the imposition of fines and confiscation of the defaulter's property. Nevertheless there are cases where the set rules are strictly adhered to. The rules governing hygiene at the water source were found to be followed immediately after construction.

Study findings show that SASOL with assistance from an independent NGO and ministry of health train community members mainly on health and sanitation, community leadership and natural resource management. This training is mainly based on participatory rural Appraisal methodology.

The process of sand dam construction as employed by SASOL, is apt and readily replicable in other ASAL areas around the globe. This is further supported by the fact that the sand dam technology has undergone the most severe test of all- time and lends itself to participatory methodologies.

Collective self-help spirit is the key to ownership and maintenance of the developed structures. When well implemented, the resultant effect is increased access to water. This leads to improved livelihoods and hygiene in the community. This is only possible when the process is facilitated by an organization, which caters for collective as well as individual effort.

The quality of water depends on the stage at which the dam has attained. Casually, water scooped from sand in mature dams seems to more hygienic than that fetched from the stagnant water in the newly constructed dams. Moreover, majority of the mature dams have off-take wells which are either communally or privately owned. Compared to the stagnant water in the dams and scoop-holes, the wells are less prone to contamination. However, quality testing is yet to validate or invalidate these observations.

The increase in water points through sand dams was established to have eased pressure on the few existing water points, consequently this had a bearing on the quality of water. From the various sources, community members choose on what sources to commit to different uses.

Negative impacts can occur through increase of water borne diseases especially by neglect of appropriate hygiene practices. Overall, community ground water management has an overwhelming positive impact on human livelihoods and household incomes, which consequently have a bearing on the people's health.

Generally, it can be said that the availability of water has translated in to improved personal hygiene in the households (and in the community) as reported by the community members. Hygiene practices such as bathing daily, washing of clothes regularly and cleaning of utensils have increased.

The increased use of water in horticulture could be seen as a pointer that the people have more crop varieties that are crucial in improving the people's nutritional status. Kitchen gardens have increased in the area as a result of availability of water and cabbages, tomatoes, onions and kales are grown in most sand dam sites either for sale or domestic consumption.

Community members said that one of the spin off impacts of the project was cleaner homes and surroundings. This was as a result of the awareness raised during the various trainings which are part of the project activities. In addition the catchment areas have been protected and the environment looks much greener especially around the water points.

In addition it should be noted that people have used the water to construct new brick houses with cemented floors. These houses are also iron roofed. This has only been possible due to improvement in income sources resulting from sale of horticultural crops. As such people feel that they live in better houses and their status has improved. Before the sand dam project was introduced many people lived in grass thatched houses which were described as less hygienic and depicting low status.

RECOMMENDATIONS

In view of the study findings the following recommendations have been made.

- The dormancy of the sand dam committee has an impact on the way the water sources are managed. The poorly managed dams are of lower hygiene levels compared to the ones that are well managed or where the management committees are active. There is need to address the issue of post-construction dam committee functions. Thus there is need for the project agency to embark on a programme to strengthen the management structures of the sand dams.
- There is need for follow up training on health and hygiene aspects that impinge on the quality of water in the sand dams. This should be accompanied with training on sand dam management as it pertains to natural resource management.
- There is also need to assess the negative health impacts of the sand dams with a view to develop strategies to mitigate such impacts. This has been prompted by the fact that the sand dam has stagnant water in most of the times during the filling stage and this could be a source of water borne diseases.
- There is further the need for scientific test of the quality of water in the sand dam to gauge the extent to which the water is safe for drinking purposes.