**SAHELIAN SOLUTIONS FOUNDATION**
**SASOL**

# Creating Food Security with Water & Trees

## An Evaluation

**For Mennonite Central Committee & Canadian Food grains Bank**


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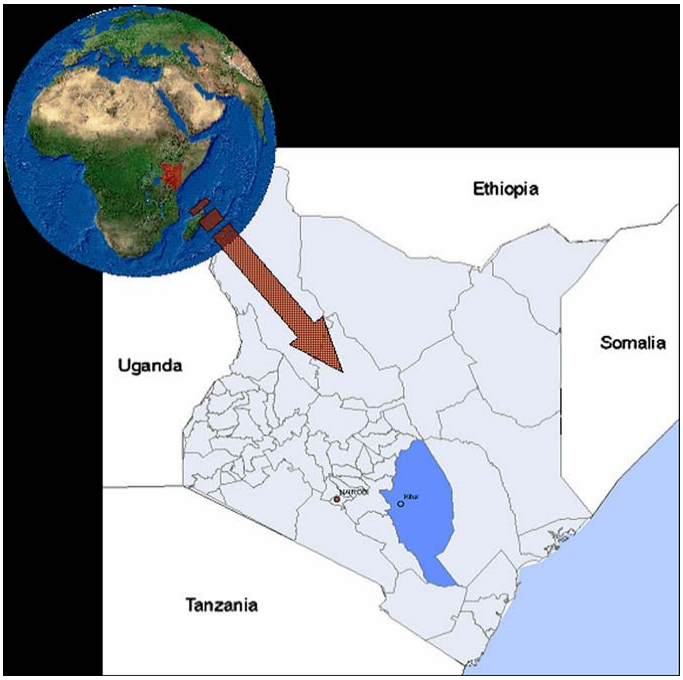
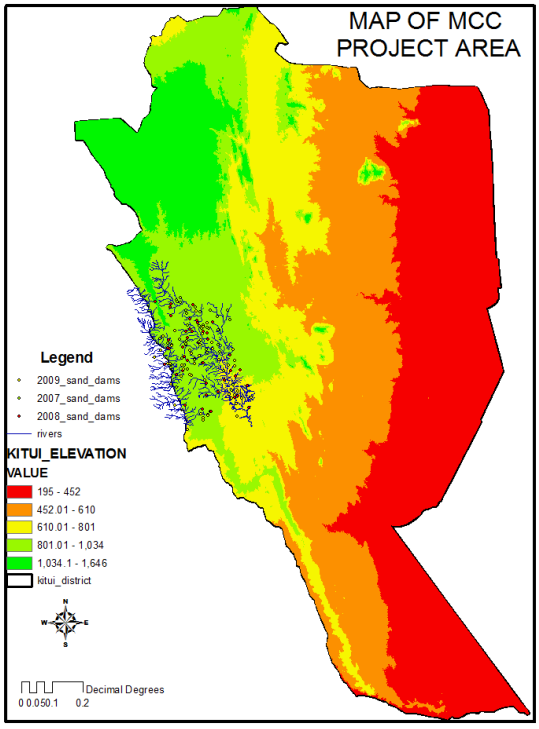
## Maps




General Location: [1] Due east of Nairobi, primarily in the Ukambani Region




Within Eastern Province, the Sand Dams over the past five years have been primarily in the West/Central area as shown in map 2 (map 2, courtesy of H. Manzi)

1 M.Ertsen, R.Hut 2009

**Executive Summary**

SASOL – *Creating Food Security with Water and Trees* - Sand Dam program evaluation
MCC and CFGB have provided support towards the construction of Sand Dams in Eastern Province, Kenya since the mid 1990's. Supports for the construction of Sand Dams was provided in order to reduce the risk of severe hunger and death to vulnerable population in this area of Kenya. Here, a lack of water has a devastating affect on food production as well as on household and personal needs.
This report paints a qualitative picture of how SASOL's program 'Creating Food Security with Water and Trees', starts with a new group organized with assistance from local government for the specific purpose of sand dam construction and then moves on to using that committee to building food security in the community. The report notes SASOL's leading role in bringing SD's and their impact on the environment to worldwide and particularly European academic attention. In general the evaluation found that there has been the creation of more food security by using water and trees, in spite of the fact that Kenya in general and this area in particular, is in the grip of a three-year drought with only slight relief from moderate rains earlier this year. The findings also affirm the approach of working through the local government. Strong benefits have come first to women, but with knock on effects benefiting men, families and the community as a result of water closer to their homes. While training is having a positive result, the findings recommend changes in methodology in order to include more training, which is being requested by the communities, and to broaden the scope of the number of people that are trained. Broadening of the mandate of the initial committee formed to provide more avenues to engage and advance the community on the road to food security is encouraged.

**General introduction**

Sand dams are barriers embedded in seasonal riverbeds**, which** hold sand and water in the upstream reservoir. They facilitate the percolation of water into the surrounding soil recharging the ground storage. The water migrates bank wards during the wet season and drains towards the channel during the dry season. The sand dam then regulates the water level in the river sands as well as the surrounding area. Because the water is held underground, evaporation losses are low and water is useful for much of the year. (Munyao, J., Munywoki, J., Kitema, M., Kithuku, D., Munguti, J. and Mutiso, S, 2004).

Sand dams are built by digging a trench down to the bed rock and putting a dam structure across which allows the water to flow over, but dropping its load of sand on the upstream side of the dam structure during the following rainy seasons. The sand accumulates behind the dam holding water in a low evaporation "tank" as it were. It may take five to seven years for the sand to reach the top of the dam so that the maximum amount of water is held. At this point the dam is considered "mature". Multiple dams (in cascade) are the norm and are built anywhere from a few 100 meters apart to as much as 1.5 kilometers between dams.

Water in the sand dams is used to varying degrees for household consumption, for livestock, and for irrigating vegetable crops, fodder crops, and trees. The extent to which the water is being used for irrigation varies from location-to-location. Most of the irrigation is being done on small plots of land immediately adjacent to the streambed. If sand dams are built in 'cascade' (several sand dams in sequence on the same stream) then the potential of offering a large population access to water and small-scale irrigation is considerably enhanced.

The most common form of accessing the water is via a 'scoop hole' dug in the sand dam bed. In some locations the water is found less than a foot from the surface of the sand bed. In other cases it involves digging into the sand bed several metres. In some locations there is standing water (a surface dam) or water pools immediately below the dam structure (barrage).

Early sand dams constructed in the Kitui District of Kenya since colonial times. Canadian Food grains Bank and the Mennonite Central Committee have been offering support to two local NGOs building sand dams since the mid-1990s.

The purpose of this evaluation was to look at the sand dams in the Kitui District of Kenya which have been built with the aid of CFGB/MCC in partnership with the Sahelian Solutions Foundation (SASOL), to see how the quality of life has changed (for better or worse) for the participating communities, with emphasis on the effect of sand dams on food security. Specifically the evaluation looks at the impacts of these dams in the context of the larger questions of efficiency and effectiveness of the dams for addressing the long-term food security of the communities where these interventions have been used. Is the response sustainable? Are they a cost effective solution? Are all of the outcomes that are appearing, planned and unplanned, either contributing to an improved community or if not are the negative outcomes of such a nature that they can be controlled or overcome? What flags and recommendations can be suggested by the evaluation that might be of assistance to SASOL in the future? (See Annex 1)

**Literature Review**

Although SASOL has been in existence since 1990, it was not until 1995 that SASOL made the strategic decisions to devote themselves to the creation of a foundational water resource. They decided that they would build sand dams and that they would concentrate in the Kitui District ("SASOL Milestones, p.17.). The first dam was built on the Kiindu River that year. Since then they have become known internationally and academically as leaders in sand dam research and have built over 700 sand dams ("SASOL Milestones").

There have been many studies done on sand dams in this area. (See Annotated Bibliography Annex 3) At the beginning most were of an engineering and hydrological nature. These studies concluded that the dams were well built and in fact, probably over built for the conditions. An additional observation was that they are built on hydrological sound principles.

Munyao, J.et al., (2004) describe the environment in which sand dams are being built as semi- arid regions with a poor population resource balance (p.4). The short rainy season consists of high intensity precipitation, over short to very short periods, and most of the water is not absorbed but runs to the ocean through seasonal river beds. The substratum is metamorphic rock with periodic sand deposits. The soils of the area are: black cotton, red clay and sand. This type of area lends itself to the building and use of sand dams which collect the water and store it underground in sand deposits which build up against the dam (p. 5). Technical difficulties, which have arisen, deal largely with things such as poor site selection, contamination by animals, chemicals and salt build up (Rempel et al. 2005).

Lasage, R., J. Aertsa, G. -C.M. Mutiso and A. de Vries (2008) did research on 500 sand dams in the Kitui District in Kenya, developed over the last 10 years. Their study showed that the sand dams have a large impact on the local community. In 10 years time, more than 100,000 people had better access to water through this relative low cost measure. The increased water availability, especially during dry periods, resulted in higher farm yields and increased crop diversity. The average income of farmers living near dams rose 60% from farm, brick and basket manufacturing. The local downstream water balance was marginally influenced as the sand dams stored less than 3% water passing the dam.

Rempel et al., (2005) details many of the difficulties, which have been encountered in the community ownership of a sand dam. These range from the imposition of the dam and site selection by outsiders, with the expectation that the community will come on board later, ownership of surrounding land, good leadership both at the time of building and later as well as on-going capacity building of participants.
The Rempel report also felt that current farming practices do not reflect the economic value of water within a farming system. There is little awareness of the investment potential of using water for agricultural activities where the highest rate of return per litre of water is utilized. The report concludes with the possibility of a "tragedy of the commons" scenario where water conservation is not practiced as community action may not recognize a need to conserve scarce water supplies, especially in time of drought, to assure water will be available for human consumption and other essential uses of water (Rempel, 2005).

The key pertinent findings in the research and literature relevant to this review have been:

1. The social organization managing the sand dam (SD) is an extremely important part of the SD paradigm and failure to provide training, capacity and a plan for ongoing involvement will be detrimental to the sustainability of the SD as a tool for food security (Rempel, 2005).
2. There has been, prior to this project cycle, a weakness in demonstrating that farmers understand how the various factors – soil, water, vegetation, animals and humans – are inter-related (Rempel, 2005).
3. Little documentation was found in any of the literature concerning cost/benefit relationship that arises from food, tree crops, livestock and new income generation allowed by more water.
4. Dams in series or "cascade" are more effective than a single dam for allowing water to migrate further up the banks of the river allowing more potential land for farming.
5. Attention to detail for anchoring on absolutely clean bedrock is essential for an effective seal and strength of a dam.

**Project Impacts**
A team review of impacts and outcomes is contained in Appendix 3

**Evaluation Process**

A team of evaluators visited 4 communities in the Kitui District of Kenya, which had recently (within the last 10 years) joined SASOL and built sand dams across a seasonal riverbed. The team was comprised of two external evaluators and one evaluator from each of the two co-funding donors. A SASOL program officer and site field officers were present for logistical support, back up reference information and translation.

Team Members:

Dan Maxson -Team Leader - External
Belinda Mapesa - Gender & Peace - External
Sam Vander Ende – Canadian Food grains Bank
Jacob Stern - Mennonite Central Committee
Hilda Manzi – designated SASOL representative

It should be commented that SASOL took the extraordinary step of retaining a former employee, Ms. Hilda Manzi, who was also a contributing author to the Rempel report in 2005, to act as the agency representative on the evaluation, as well as retaining 3 outside translators that *were not* part of SASOL. The SASOL Field Officer stayed with the vehicles, away from the actual focus groups, so that there would be no hesitation or bias on the part of the beneficiaries in responding. SASOL is to be commended for this. Few agencies are that aware of impact of having their own people translating for an evaluation.

**Data collection**
This project used a non-random sampling process. The villages were chosen by the SASOL, with the majority of those coming from the villages that built dams in the last 5 years. Those respondents who were interviewed were sampled using a convenience method, as they had shown up for a group meeting on the dam site. The majority of people available to talk and the majority of village were female-headed households.

This evaluation employed a mixed methodology, ensuring the collection of both qualitative and quantitative data. Types of data collected included interviews with both closed and open ended questions, group discussions, focus groups, observations, and in-depth interviews. The same topic questions were asked of each topic group by the same team member. Numerous reports, records

and other materials[2] were reviewed. Individual interviews were mostly conducted during the field walks through the sand dams and farm visits during the first hour of every village visit.

The team divided up the evaluation of sand dams as an intervention into four primary parts. The first sector addressed the issue of food security from 1) a crop / farming system perspective; and 2) from a trees, and livestock perspective. The next sector addressed 3) how the intervention changed the community from a social perspective - especially women and families; and 4) based on the literature and experience with these two groups in the past, the question, is the critical element of sustainability influenced more by the social management unit or the technical element of the dams, was explored.

Focus groups were formed by the self-selection of individuals, who would identify with the topic that they most associated with. If the groups became too large some of the members from one group moved to another in which they also fit.

In each of these sectors the team members were asked to note key findings, present an analysis of the findings, identify strengths and weaknesses of the projects, including lessons learned and recommendations to guide future programming connecting the intervention with food security.

**General Findings:**

A fundamental assumption that under-girds sand dam technology is that water will be available closer to the home – for household use as well as for productive purposes. Sand dams bring change - a change that represents a significant time saver to the household – and does make water more readily available to the household. However the change is not immediately realized, for it can take up to seven years for a sand dam to become fully 'mature'. One key interest of MCC/CFGB is to establish if this saving in time & supply of water translates into a significant and quantifiable food security impact for the household and the community.

At the time of the assessment visit, the region was in the peak of a dry season – anticipating the short rains to begin in October/November. Additionally, people were feeling the collective impact of three years of rains that had performed poorly or even failed. Evidence of the impact of this severe dry spell was seen and heard everywhere. Crops performed poorly and coping strategies were being exercised to varying degrees in all communities visited. This has multiple implications, the first being the fact that the dams are perhaps maturing more slowly than normal, as they need the rain to deposit the sand to make the dam work. This represents a significant setback for SASOL. Momentum is curtailed and the focus of activity shifts.

In all communities visited (except one) the sand dams were retaining some water on a continuous year-round basis. The volume of available water supply varied considerably. Given the agro-ecological profile of the Kitui area – an arid and semi-arid land – sand dams provide a very significant change for the environment and an important new asset for the people. For communities with sand dams and other complementary services, agriculture is a *less* risky enterprise now than before the sand dams were built. In communities with sand dams that contain water in the sand bed year-round (or at least most of the year), the people can better withstand the impact of drought and can recover more quickly from the drought once the rains have recharged the sand dam and the water table.

Most of the communities visited by the team are relatively new to SASOL. All have multiple dams. Only one SD was "mature" or full of sand. In this area it takes up to seven years for maturity against the five for many other areas. One of the dams was built in 2000 with a cascade of 10 dams. The other four communities built their dams in the last three years. Terraces go up to the crown of the riverbank, which are not high in this area. Vegetable gardens are usually only in the first one or two terraces where water is carried by bucket. Terraces further away from the sand dam are reserved for rain fed field crops. Many of the dams still have room for extensions. The (re) building of terraces is an endless need. Additional sand dams are always desirable. The full potential of sand dams has not been maximized yet. This means that the water table has not yet

2 Rempel, H. et.al, (2005) *Water in the Sand: An Assessment of the Agencies Kitui Sand Dams Project*,

risen to its fullest extent so all findings are viewed in this light.

The condition of the sand dams varied from community-to-community. In Kamale there were small quantities of water available found in 4 metre deep scoop holes. In Kathooyoni water was not being extracted from the sand dams. However, two water wells located not far from one sand dam were reported to have water year-round now. In Kithinliani – this is a new site (2009) – the one completed sand dam is reported to have recharged the water in a shallow well (built by ADRA) located near the sand dam. Also, it was also mentioned that the well was quite saline before – but now the salinity is considerably reduced. Maito SHG sand dams and adjoining off-take wells were all dried up (since March!). Water was being ferried from some 5-6 kms away (from two different sources).

Water in the sand dams is used to varying degrees for household consumption, for livestock and for irrigating vegetable crops, fodder crops and trees. The extent in which the water is being used for irrigation varied considerably from location-to-location. Off-take wells are the preferred method for accessing water from sand dams. In one village, the most common form of accessing the water was via a 'scoop hole' dug in the sand dam bed. Due to the length of the dry period scoop holes were observed to be quite deep into the sand bed of the seasonal stream. Water from the sand dam was most commonly observed, as being transported in jerry cans – most frequently is being carried by donkeys and sometimes carried by people. There were no reports of farmers owning mechanized (ie. treadle pumps) or motorized pumps.

It is to be acknowledged that the sand dam – although built under the supervision of 'sand dam project committees' a representative group of the community with support from SASOL, - are in many respects a community asset. That is to say, an unspecified number of people from the community are also using the water from the sand dam for their household needs. In terms of assessing the true benefit of the sand dam it would be useful to assess the total number or percentage of households using water from the sand dam.

> [NOTE: whereas sand dams are considered as community assets, water from the off-take wells are under the control of the members of the sand dam projects. Membership is open to the whole community and members pay fees (Ksh 50/month) for the maintenance and upkeep of the well.]

**Food Security**

**Crops and cropping practices**

*SASOL* has not limited itself to simply building sand dams – assuming that the asset created would catalyze the development process. *SASOL* is also providing some accompaniment in the form of training in crops and cropping practices. The emphasis is on introducing or promoting drought tolerant crops, vegetable production, tree planting and fodder/grass crops. *SASOL* is developing a new syllabus on "dry land farm management" to supplement the "natural resource management" manual most commonly used in previous years.

Maize unfortunately continues to be the main staple of the diet. Maize, more often than not, performs very poorly in the area – and hence is a contributing factor to chronic household food insecurity. *SASOL* has made some modest efforts in promoting drought tolerant crops – several of these crops could easily become a substitute or replace the current maize-based diet. The main drought tolerant crops are: sorghum, finger millet, pearl millet, cow pea, pigeon pea, green gram, dolichos lab lab, sweet potato and cassava. Some of these crops are being newly introduced into the cropping mix. Drought tolerant crops are grown under rain-fed conditions. In focus group conversations, it appears that there is considerable variation in terms of which drought tolerant crops were being grown.

With the presence of sand dams there are now many more people with small kitchen gardens. Kitchen gardens are largely limited to household consumption. In all communities visited there were always a small handful of people still able to tend a garden.

Grass & fodder crops are also part of the cropping system being promoted by *SASOL*. Most of

these crops having a dual purpose of soil and water conservation and providing food for livestock. In addition to the local indigenous grasses, *SASOL* is promoting fodder crops such as: Napier, Vetiver, Boma Rhodes, and Leucaena.

**Irrigation**
Water in the sand dams is used to varying degrees for irrigating vegetable crops and trees. The extent in which the water is being used for irrigation varied considerably from location-to-location – and availability of water.

Irrigated agriculture is NOT a new innovation for the people in the area as many have seen or been involved in small-scale irrigation that is occurring on the banks of the Tiva River. What IS NEW, is the promise that communities with sand dams that retain water for several months after the rainy season are now able to have irrigated gardens on their own *shambas*.

Currently, in *SASOL* operational areas it was observed that only a few people were irrigating small plots of land immediately adjacent to the streambed. The one clear exception was Kamale Vegetable Grower's Association – which had new life being injected into it with the support of a FAO grant for 41 male farmers to install modern high quality drip irrigation systems (an FAO grant being implemented by an Italian NGO with Israeli technology) to irrigate modestly sized gardens. These same farmers have been irrigating their gardens using the water from several SASOL constructed sand dams for several years, employing the 'scoop and carry' channel type of irrigation for a number of years. Most of the vegetables have been produced for sale in nearby markets. A key point of this narrative is that these farmers are producing irrigated fruit and vegetables during the height of a severed dry spell where water is scarce – largely due to three seasons of failed rains. It bears mentioning that the 'scoop holes' In the sand dam stream bed were 10'-15' deep and only small quantities of water were seen.

**Crop Production – all sources**
As stated elsewhere in the report, the *Ukambani* region is chronically food insecure. The people of the area are currently suffering from three years of failed or inadequate rainfall.

A couple of quotations from farmers:

> *"This year has been exceptional bad. In normal years crop production is enough … sometimes there is a surplus.*
> *"If I had not dug the terraces … there probably would not have been any harvest."*

Drought tolerant crops are also NOT NEW to the area. However, uptake in planting of drought tolerant crops has been patchy. *SASOL* has been giving drought tolerant crops some limited attention. In the focus group discussions, data was gathered on total amounts harvested by each household. And as is to be expected, production of drought tolerant crops is as yet, very small and is only making a modest contribution to overall household food security. For the moment, maize still is very much the main staple crop.

Total land cultivated is highly variable from location-to-location. The range of land cultivated, as reported in the focus groups, was from 10 acres to as little as 1 acre. An average of land cultivated across all focus groups interviewed is approximately 3.5 acres. Access to sufficient land does not appear to be a limiting factor in this area. The challenge is more one of getting reasonable levels of production from the land.

In a couple focus group discussions, people reported the 'greening up' of the area around the sand dam and to some extent up and down stream of the sand dam. The most frequent explanation is that the sand dam has raised the water table. This phenomenon is affirmed by the assessment team.

Information gathered from the focus group discussions appears to suggest that most households have 'kitchen gardens' that produce gardens vegetables to serve household needs – until the water supply has dried-up. There are a few individuals producing modest surpluses of vegetables

and making a bit of income. Availability of water was a determining factor as to how many months after the cessation of the rains people were able to keep kitchen gardens.

The number of people using water from sand dams or off-take wells for kitchen gardens appears to be increasing from year-to-year. The most common crops being irrigated are: kale, tomato, onion, pepper, spinach, mango, paw paw and banana. There was only sporadic evidence of forage/fodder crops having successfully taken-off.

With the construction of sand dams *'in cascade'* the potential to radically transform (environmentally as well as for productive agriculture) the entire catchment area is extremely high. However, due to the long dry spell being currently experienced in the *SASOL* operation area – the full potential of the sand dams is not being realized – though all communities are hopeful for the approaching rainy season.

**Consumption & sale of produce**

At the time of our visits to the communities, people were reporting varying levels of household stocks – some households had already used-up their crop production since March/April. A few people with grain in their stores expected to hold out until December. The bulk of the respondents reported that their supplies would be depleted by October. When household stocks are exhausted they resort to varying forms of *coping strategies* – labour migration and selling livestock being the most common. In a couple communities there was an expressed expectation that *SASOL* would once again engage in a *food-for-work* response. It is to be noted that many communities in the *SASOL* area of operation have been served by a USAID funded multi-year (2005-09) FFW project being implemented by either ADRA or CRS.

> [Note: September/November corresponds to a critical hunger gap period for this area. The Kenyan meteorological agency is reporting that the anticipated short rainy season rains will NOT perform well. *SASOL* management has indicated to the assessment team that they are gearing-up for another round of FFW with the approval of their recently submitted proposal to MCC/CFGB.]

At the time of the assessment, almost all respondents in the focus group discussions reported that they currently are NOT producing enough staple crops to last from one harvest until the next. Most households that engage in 'kitchen gardening' report that current production fulfills most of the household needs (only resorting to buying when the water supply becomes difficult). Only in a few cases was there a small amount of surplus production that is sold locally (except Kamale). The DAILY consumption of vegetables for most households represents a new addition to their daily diet. Consumption of fruit (mango, paw paw, citrus) is also a new food for many households.

Resistance to more fully incorporating drought tolerant crops into the diet might be overcome with demonstrations on cooking/ preparing tasty dishes to overcome old prejudices or lack of knowledge.

**Sustainability - soil & water conservation**

The relationship and interaction of the environment with human presence is complex. For the *Ukambani region* it has to be of necessity, a delicate balancing act. Erratic rainfall, hilly/mountain landscapes denuded of trees and shrubs have exposed the region to severe erosion and degraded soils. *Climate change* is a daily life reality in this part of Kenya.

Based on feedback given in the focus group discussions, the single most important intervention (after the sand dam) is the construction of terraces (with trenches on the contour). Terraces/trenches have made notable impacts in conserving soil and in retaining moisture – which then have the continued effect of improving crop production. Many people made mention of having received training in composting and use of animal manure, however, we were not often able to observe these interventions being put into practice.

It is noteworthy to mention that besides *SASOL*, an American-based NGO, ADRA is also working with local populations in the improvement and construction of terraces as part of a FFW program.

There were several comments made about the different standards of construction being employed by both agencies. This is yet, another example highlighting the need for NGO coordination and collaboration.

In terms of assessing the environmental impact of *SASOL's* programme, a frequently heard response from focus group respondents is that the work of *SASOL* has "raised-up" the subterranean water tables. Improvements in the water table promote growth and development of naturally occurring plants, trees and shrubs. More vegetation means that there will be less erosion. There is an expectation that an over-all 'greening' of the environment will also positively contribute to longer growing seasons for crops and improved yields.

The re-vegetation of the catchment areas immediately adjacent to the sand dams is of critical importance and often lacking in the areas visited. Without due priority being given to this activity (on-going basis), it threatens the sand dam and erodes the environment. The message needs to be frequently repeated to the people of the community. Indigenous plant species, as well as Napier grass and Vetiver need to be promoted. Frequent inspection by SASOL staff of the status of the catchment plant life is essential.

**Training**

Operationally, *SASOL* employs a 'flat' structure. That is to say, management is expected to involve themselves in field operations – in support of the staff who are tasked to manage AND implement field operations. The MCC/CFGB funded project has two *Field Officers* who are based in Kitui and are expected to cover all operational aspects of the 50-odd sand dams being built every year with MCC/CFGB support. This is a *'herculean task'*. Between the two of them they organize the communities, mobilize the skilled workers, facilitate the training, do the follow-up work, collect data for monitoring & evaluation and do report writing. These staff are not only the critical link between *SASOL* and the communities, but also act as the primary links with government staff (ie., Extension Officers & Development Agents).

*SASOL's* principle environmental / agricultural training manuals are:

1. *"Natural Resource Management Training of Kitui Sand Dam Communities"*
   The keys topics covered:
   - Land degradation
   - Soil management
   - Water conservation & management
   - Utilization of farm produce
   - Tree & vegetation management

2. *"Training Manual Guide for Dry Land Farming"* (still under development)

The key topics covered:

- Land preparation
- Soil fertility
- Weeding
- Harvesting
- Seed selection & sourcing
- Planting
- Pest & disease control
- Storage
- Marketing

SASOL is currently shifting the focus slightly and is developing a new syllabus or guide for dry land farming practices – with the emphasis on "equipping farmers with better dry land farming techniques for improved food production".

*SASOL* facilitated trainings are offered to a select number of people in each community. The expectation is that the content of the training will 'trickle-down' into the rest of the community. Most of the training takes place in the villages – as classroom events. Only a few trainings occur on farmers' fields/*shambas*. Exchange visits are also organized by *SASOL* and have generally been very well received by community representatives as an effective means for communicating new ideas and concepts. People are asking for more training.

**Other interventions - FFW**

Due to the prolonged drought, f*ood-for-work (FFW)* has become a regular – but necessary complementary aspect of community food security. Multiple seasons of failed rains have necessitated this response. The main provider of FFW has been the USAID funded NGOs: ADRA & CRS. According to community members the program ran from 2005-09.

*SASOL* has also engaged in a limited form of FFW using MCC/CFGB resources. FFW is a response that *SASOL* engages-in reluctantly s a necessity to see people thru the peak of the hunger period (4-6 months). . A key indicator of 'distress' is when participation rates during the construction of the sand dam fall-off. Once *SASOL* has satisfied itself of the gravity of the situation, they prepare a proposal, which is submitted to MCC. FFW is usually confined to terracing and tree planting so as not to interfere with the labour on the sand dam.

**Findings: Livestock in the Farming System**

As evaluations were made of SASOL's sand dam communities, the findings indicate that animals as well as people are more healthy and productive because sand dams make available clean sand filtered water near their homes. In some instances, animals are available for work for the whole day that was formerly spent going to a far away watering point before the sand dams were built. Sand dams provide water nearer to farms that make zero grazing possible, which help animals produce more milk and meat while reducing the cost of labor. Animals are important to this program because the Kamba people always have animals as part of their farms under free-range system. The disadvantage of this system being keeping large stocks of animals that overgraze the land causing soil erosion, less healthy and collection of manure for farm use is often difficult.

Healthy animals are an important food source, both for meat and milk. Animals are critical to this program because they produce manure, which is essential to the growing of good crops. Proper marketing of animals can be a source of income for purchase of food by the farmer during the dry period (hunger gap).

The number of cows owned by farmers in many groups had gone down due to the severe drought for the past three years. Some groups reported over 75% of cattle sold or died. For example, between 2007 and 2010 in Kamale Community group, cattle numbers decreased by 81%, because cows were sold for food or they died while the number of goats/sheep increased by sixty three percent. But in Kathaayoni Community group, where there is more sand dam water due the fact the river flowed during the rainy season, between 2008 and 2010, the number of goats/sheep and cattle went up—goats/sheep by 83%and cows by 121%. In Kithiiane community, the increase from 2008 to 2010 was 48% for goats/sheep and 47% for cows. At Maito group, the trend due to the drought seen in other parts of Eastern Province with groups surveyed was of the number of goats going up and number of cows going down—goats/sheep a 45% increase and for cows a 54% decrease. One reason for this is that the number of goats that survived the drought is much greater than the number of cows that survived: community members noticed this and many have decided that goats are a better investment for their farms especially as a drought coping mechanism. The indigenous grasses in the Yatta Plateau can be used to pasture animals and should be cut and stored as hay for use in the dry season. The ability of goats to browse legume bushes for protein, gives them a great advantage over cows, giving the farmer more profit and

sustainability.

Traditional chickens are common in most shambas, used for gift giving on special occasions and are important for food. Chickens did not die off during the recent 3-year drought. Very few farmers raise chickens for sale, but many expressed interest in poultry farming, and asked for training in this area. The price of eggs has continued to increase over the last 3 years. Increased water from sand dams increased the number of chickens dramatically in all groups.

**Lessons learned: Livestock**
Goats survive drought better than cows. Culling and selling animals that might not "make it" before the drought is a good management practice that needs to be taught. With more training the adoption of culling and selling as well as planting fodder shrubs, will make animal production more sustainable if not profitable.

Drought has taught the farmers the necessity of changing their practices to be more in tune with what works in drought conditions--eg. Planting drought-resistant crops, more goats and fewer cows.
The expansive uncultivated land in Yatta District can become a source of hay, fodders and animal feeds that can be harvested and properly stored for use during the drought.

**Findings: Trees**
Nearby sand dams and off-take wells provide water for SASOL project group tree nurseries. Without water from these dams/wells, tree planting would not be possible. Trees must have water during the dry seasons to make it through at least their first two years. In short, without sand dam water, SASOL's groups would not be able to plant and enable the large number trees to succeed. The significance of trees is that they can be used as fodder for animals, source of firewood, timber and very useful in the conservation of water catchment areas e.g. areas where sand dams have been constructed along the river channel.

**Findings from focus groups on trees:**
Groups are planting large numbers of trees even in the drought, and are not deterred even if they are losing some. Irrigation water from sand dams/wells is used to help many more of these trees to "make it." The number of fruit trees is increasing, especially mango and papaya. Mango trees survived well during the recent three year drought and the fruit can be sold for 10 Ksh/fruit. It can be eaten or sold to help lift members out of poverty. Other fruit trees that are good for food and sale include avocados, guavas, passion fruits and citrus. Custard apple and dessert date trees also do well in the dry areas where SASOL works.
Timber trees include Melia volkensii, Croton megalocarpus, Eucalyptus saligna, Grevillia robusta, moringa oleifera and neem. Members find it easy to plant "wildling" Melia volkensii seedlings growing under mature trees and transplant them in their farms. Sienna siamea and Jacaranda are also important timber trees.

Community members reported that they really liked growing trees for environmental reasons. They also noticed that the best farmers were planting many trees. It is important to note that as members become interested in more intensive animal production, planting fodder shrub legumes like Leucaena and Sesbania sesban can be done for the provision of fodder.

Trees that should be planted for their medicinal value such as Moringa oleifera also known as the "Miracle Tree" and Neem can improve people's health .e.g. Neem grows well in dry areas and eating a neem leaf a week can help keep people from getting malaria.

The increase in the planting of timber trees and fruit trees during 2007 to 2010 was obvious in the communities by the following (focus group data)

| Community / Location | Tree species | Increase between 2007 - 2010 |
|---|---|---|
| Kamale | Timber | 03% |

| | | |
|---|---|---|
| | Mango<br>Papaya | 50%<br>20% |
| Kathaalyoni | Timber<br>Mango<br>Papaya | 61%<br>409%<br>4000% (from 5 to 212) |
| Kithiiani | Timber<br>Mango<br>Papaya | 2600% (from 7 to 188)<br>2900% (from 3 to 89)<br>500% |
| Maito | Timber<br>Mango<br>Papaya<br>Custard apple<br>Mulberry<br>Citrus | 57%<br>35%<br>194%<br>950%<br>950%<br>138% |

**Lessons learned:**
Tree planting is something the community was taking seriously. Planting of mangoes, papaya and melia volkensii was very high.
The species of trees being grown by the community members was very wide and diverse.

**Family & Community Relations**
SASOL Foundation is one of the many community based organizations in *Kitui* area. The communities which live in this area have been experiencing limited or erratic rainfall. As such attempts by these communities to be food and water secure are a day-to-day challenge even for an organization such as SASOL.

SASOL prides itself in its mission statement that indicates it empowers and supports communities, structures and skills relevant for sustainable utilization of resources to improve their livelihood. To achieve this mission SASOL uses the sand dams' technology to enhance the capacity of the communities it works with through active participation of community members, planning with partners and exchanging ideas with the community members. This report reviews how communities under SASOL have worked together with SASOL to improve their food and water situation as well as highlight the impacts women have experienced and witnessed within their families and the community.

**Major Findings**
1. There is evidence in the reduction of the effects of hunger to families and the communities at large. Families visited reported that they are progressing, though slowly to dealing with the usually harsh hunger gap period conditions to developing coping/survival mechanisms, the families in this region have witnessed minimal food security and an irregular water security at varying degrees.
2. There is a significant change in the roles of women, men and children in the family and the community. More and more women are taking roles outside the homestead such as leadership, and men share the burden of providing for the family with their wives while the children share household chores among themselves thus assist their mothers in housekeeping.
3. The team observed that there is a clear improvement in the health status of families in particular and the communities as a whole including their livestock due to the construction of the sand dams.
4. The families and communities assessed reported that they are enjoying improved living-standards which is indicated by the ability of families and the community to construct permanent houses and their ability to provide nutritious food for their families due to the sand dams.
5. Many of the women interviewed indicated that they have acquired new farming skills and proper education through the SASOL trainings and workshops, which has enabled them to cultivate their farms wisely and care for their families better.
6. Among the four communities visited, three communities hinted that there is minimal increment

of migration of people to the area. These new migrants are easily accepted in the new communities. In addition community members who had migrated to other areas in the country are moving back to the sand dam communities. This is basically because people moving in these areas have heard of the benefits of the sand dams constructed and there is land available for them to cultivate.

7. The communities visited clearly stated that the sand dams have not caused any conflicts in the families and the communities. However the women in *Kamale* community reported that they were dissatisfied and unhappy over the criteria used to issue drip irrigation kits offered by FAO and Agrosphere through SASOL – leaving them non-eligible This state of affairs has stirred envy, jealousy, resentment and competition first between family members and also between members of the community who possess the irrigation kits and those who do not have it.

8. The women in this region have reported that they have experienced minimal or unchanged supply of firewood for their families before and after the construction of the sand dams.

9. The communities visited reported that the distance and time they use in fetching water has massively reduced.

**Analysis of the major findings**

The families interviewed have experienced immediate and longer-term impacts from the construction of sand dams in different levels in the communities.

**Immediate impacts**

These are the impacts which the women, their families and the community benefit from directly due to the construction of the sand dams.

a) Reducing hunger

The sand dams are enabling families to be in a better position to deal with the effects of hunger. This is largely due to the availability of water and the raise of the water table levels in the farmland around the sand dams. As a result families can cultivate vegetables and other food crops in their farms to sustain them through the hunger period. In addition for families whose farms are not near the sand dams benefit from the general raise of the water table in the area and nearness to the water source therefore they can irrigate their farms comfortably for longer period. In addition families are able to access vegetables during the hunger gap period (3-5 months) easily and at a cheaper price of which was not possible before the sand dams.

b) Reduced time and distance to get water

The distance traveled and the time used to look for water has been greatly reduced. This is mainly due to the nearness of the sand dam and take off-take wells near the sand dams. This has considerably eased the family's burden but addressing access to water and saving time.

**Long-term Impacts**

These are indirect benefits that the sand dams have bestowed to communities around them. The most profound is the empowerment of women, their families and the community alongside their male counterparts which has resulted in three types of consequences, elaborated below.

| Impact | Social and health | Economic | Decision-making |
|---|---|---|---|
| Individual level | -improved personal health (improves her diet and keeps her house clean)<br>-improved personal hygiene ( she baths regularly especially during menstruation)<br>-expands her capacity by increasing her knowledge and skills hence she can make informative decisions for herself<br>-has free time to engage in other activities<br>-engage in economic activities | - acquire economic independence from their husbands thereby increasing their self-esteem. (of which the husbands have welcomed)<br><br>-she decides how to spend her money | -she chooses her diet and meals which improve her immune system.<br><br>-decides which business opportunities to venture in.<br><br>-decides what to do and how to spend her free time |

| | | | |
|---|---|---|---|
| | such as women associations such as merry-go-rounds* and small scale businesses such as selling of vegetables. | | |
| Family level | - improved family health there were no cases of malnutrition or waterborne related diseases in the families<br>-improved family hygiene (members bath regularly)<br>-harmonious family relations (peace at home) expounded on more in the report.<br>-changing family roles and shouldering family responsibilities women are now involved in digging terraces while the children are entrusted with duties such as fetching water, cooking and fence making for older children or digging terraces.<br>-increased and steady school attendance by both boys and girls.<br>-both husbands and wives can spend more time with the family and can follow up on their children's education progress. | -expands family income by engaging herself in small scale businesses<br><br>help their husbands in the day-to-day running of the family buy contributing in the family's budget to make ends meet thus husbands are not solely burdened with familial needs.<br><br>-improves the family's standards of living since both husband and wives earn a living. | -decides the diet and the meals of the family.<br><br>-husbands and wives make more joint decisions concerning the family. Hence the two stand to benefit from each others' counsel. |
| Community level | - improved communal health (improved diet of their families hence stronger immune systems)<br>-improved communal hygiene (families can bath regularly and keep clean)<br>-engaged in activities other than household chores such as digging terraces and small scale businesses such selling vegetables and water delivery alongside their male counterparts.<br>-changing communal attitudes both men and women perceive each other as equally important contributors to the progress of the community.<br>-engages in community affairs such as attending weddings, school meetings.<br>-harmonious communal relations between men and women and families. | -improved community earnings (both men and women are earning an income)<br>-young men and women have a chance to venture in to small scale businesses.<br><br>-higher living standards due to availability of resources to in the households and increased income. | -vie for leadership positions in the SHG councils alongside their male counterparts.<br><br>-both men and women are engaged in community and they are engaged in community and Self-help group councils. However There is a steady increase in the number of women in the SHG councils in various positions such as treasurers, chairperson, secretaries and members of the SHG council. |

*Merry-go-rounds are popular associations of women coming together in groups with the purpose to increase their income. Women in Merry-go-rounds form groups of any number and the members

in the group would contribute an agreed amount of money, as agreed by the group and can be daily or weekly and would give the contributed amount to the members in turns from the first all through to the last and repeats the whole sequence again for as long as the women want to form the group.

As indicated in the table above, the sand dams have impacted in almost every sphere of the women's lives. This is mainly because women can invest their free time in income generating activities other than staying idle. Consequently the women gain empowerment and are able to rely on themselves.

At the familial level, the changes felt are accredited to the improved safety in the reduced distances to the water places. Hence, children are now involved in housekeeping duties and take on responsibilities such as fetching water, watering the animals, cooking and digging of terrace among the older children. The children therefore acquire some degree of independence and confidence in themselves. As a result, the women feel confident and free in taking on activities outside the household such as digging terraces and small scale businesses. Consequently, the traditional view of women as housewives begins to transform in the family.

The upsurge in the changing roles of women felt in the community level is attributed to self-empowerment and having more free time as well as getting a helping hand in housekeeping. Thus the women begin to engage themselves in activities outside the household. Consequently, the women are able to work alongside their male counterparts in farms and market places. Their presence alongside men has contributed to changing the attitudes of many communities which are socialized to accept women as equal contributors to the overall progress of the communities.

It is noteworthy that the close interrelation of the impact that the women, families and communities have experienced as indicated in the table are ascribed to the fact that the women apply the skills they have learned in their lives and share them first with their families and then with the community. In return the involvement of women in development projects produces a four-fold impact.

**Improved gender relations**

The sand dams have contributed profoundly to the benefit of both genders of all ages in all the three levels. The fact that men and women are engaged in the construction of the sand dams indicates that they have both realized that they share a common threat which is food and water insecurity and it respects no gender. Due to this realization men and women in *Ukamabani* have Learned quickly that being a man or a woman is not a disability but rather a unifying factor in their diversity and work jointly to construct sand dams. As a result this has given rise to individuals and families with positive attitude towards each other thus communities gradually become stable. Their concerted effort is symbolized by the erection of sand dams which serves as a possible armor from the pangs of hunger. Thus, women learn new skills (construction) which is traditionally associated with men and the men learn to work alongside women and accept them as capable partners contrary to the traditional beliefs that women are limited in carrying out certain tasks. This exchange of skills and emergence of new thinking consequently contribute to the harmonious relations among men and women of all ages in the family and the community. Therefore men and women are able to go about their day-to-day chores due to the prevailing peace in the community.

In addition sand dams have essentially contributed to the harmonization of many familial relationships. This is mainly highlighted by the reduction of constant quarrels between husbands and wives over water- related issues which strained their relationships. But with the advent of sand dams the water is closer and women can delegate this duty to children. This change has brought about peace at home and even improved the conjugal aspect of their relationships. It has also consolidated sibling relationships since brothers and sisters assist each other equally in their capacity in various household chores before and after school. Therefore neither of them feels discriminated against or prejudiced when familial chores are distributed among them. Moreover, since both men and women are able to make a living in various small scale businesses, they are able not only to increase their respective families' income but also raise their stand of living.

Further more men can now enjoy the peace which comes with the reassurance of the safety of their families whether they are home or away and can comfortably continue with their primary role of providing for their families whether at home or in urban cities.
While it is easy to assume that the sand dams have benefited women more compared to men, this is not necessarily the case. Men too have benefited equally from the sand dam projects. However theirs' are mostly indirect whereas women's benefits are more direct.

> [It is also important to note that balancing the gender equation is a delicate act that ought to be carried out with caution and guard against over empowerment. This is because it can lead to the erosion of the significance of one gender which may thereby render them 'useless' while over burden the other gender with too many responsibilities which may cause them to experience burn out.]

**Improved health**
The construction of the sand dam is associated with the improved health of women, families and the communities. Families can now have adequate water for hygiene purposes as well as cooking. To reinforce this achievement, women have undergone hygiene and sanitation training to learn more methods of keeping their families clean. In addition the families now consume a balanced diet and consume a variety of food such as Dolichos, sorghum, milk, eggs, kale, mangoes, pawpaws among others which have nutritional value for example, Dolichos lablab is high in protein and increases energy in the body. Due to its high level in protein it enables lactating mothers produce more milk which is good for the breast feeding babies because it develops their immune systems. It also gives children, women and men energy consequently improving their immune systems which give them strong foundations of growing in to a healthy and energetic community. Therefore the communities drastically reduced the probability of falling sick frequently due to waterborne and malnutrition related diseases.

**Peace and conflict**
The reason as to why the sand dam communities are not experiencing conflict over the sand dams and its resources is because community members possessing land close to the construction site of the sand dam enter in to a clear solemn oral {WRITTEN CONTRACT SANCTIONED BY THE ASSISTANT CHIEF} agreement among themselves on the ownership and access of the sand dam resources of which are the communal ownership of the sand dam and free unlimited access of the sand dam water to all members with some communities setting aside a registration fee for new members. Although this is usually a community's initiative SASOL has constantly been a source of encouragement to communities to continuously ensure that this criteria is maintained in successive sand dam communities. Therefore the communities drastically reduce the sources of conflict from within. These solemn agreements have over the years enabled communities to live in peace with each other. In addition communities understand that they are facing a common challenge which is hunger and to be able to overcome it, they realize that they need to work with each other rather than against each other.

But a peaceful community can at times be disrupted by donors with good intentions. Such is the case of *Kamale* community. The involvement of FAO and Agrosphere in this community through SASOL to donate irrigation kits has resulted in competition, jealousy and resentment within families and the community. At the family-level, mothers and sons cannot agree on who should own the irrigation kits and this has resulted in their sons keeping the kits for the irrigation of their own pieces of land. This limits the mothers' access to drip irrigation and she remains ineligible to apply for another because their sons already have the kits. This group of women is therefore left out of the entire excise. As for the young women they were totally left out because the eligibility requirement was land ownership and in this community women do not own land at a youthful age. As a consequence in a group of forty-one members of the *Kamale* Vegetable Growers Association only nine women received the irrigation kit. As for the community, women who do not own the irrigation kits feel resentful that they may never own one. Therefore, although the women of *Kamale* community are not drawing swords against their families and neighbors they are not living in peace. This is because when the donation of the irrigation kits came to an end, and an equal number of women to men did NOT own these kits, the kits will become symbols of their

'inadequacy' and limitations.

**Migration**
The increasing awareness of the sand dam technology in the country has led those who migrated from these dry areas to move back to the community. Though the numbers are not high but the fact is there are people who feel the sand dam technology is giving them an option to remain and/or move back to their once unproductive lands. Consequently, sand dams have created employment opportunities through farming to young men and women and have also contributed in reuniting families by making farming an attractive activity to venture in despite the dryness of the region. Hence men have a chance to work close to their homes and do not have to go to urban areas to look for employment thereby creating stability within the family and the community.

**Lessons Learned**
The training that SASOL gives the communities can enabling them somewhat to overcome the deficit of inadequate education. Consequently this will prove to have an impact on the lives of individuals, families and the community. Therefore SASOL must ensure that they enhance their communication skills and include the use of adult learning techniques. A community's dream to food security can be realized not only by the construction of sand dams but also enhancement of farming skills and knowledge.

Donor organizations may have the interests of communities at heart when they seek to sponsor certain projects – as happened in the case or irrigation kits. However at times, instead of helping improve a situation in the community, they introduce competing dynamics which may divert the original intentions of a project.

**Findings: Social management unit and sustainability**

Rempel in his in-depth evaluation of Sand Dams, *The Water in the Sand* (2005), underscores the importance on several levels of the social organization to utilize and care for sand dams. Aexia Haysom, in the large study of water points in Tanzania , *A Study of the Factors affecting Sustainability of Rural Water Supplies in Tanzania* (2006), found that only 45% of them were functional and that the cause for the collapse of the water point was in almost all cases related to poor financial control and management. All of this points to the fact that the sustainability of the sand dams (SDs) is going to be more about the people than the tool. With in the sector of people, the most important will be the leadership or management unit.

**Findings from focus group discussions with SASOL leadership committees**
It is helpful to describe briefly the approach/entry point of SASOL into the community in order to better understand the findings with the leadership of the various committees interviewed. The approach to choosing communities is two fold, some localities and sub-localities (administrative divisions) are not suitable for SDs due to geographic considerations. Given suitability SASOL begins by discussions with the Locality office, if the Locality is in favor and supportive the discussion moves to the sub locality and if positive discussions are held there then specific villages are engaged and a SD committee is formed and work begins on the SD. This approach of working through the government offices etc. is to be commended from the view of building capacity and in avoiding the NGO becoming a replacement mechanism for a weak government institution ie the government agencies responsible for water. It does, however, come with some problems that are discussed below.

Once the SD was complete, the committee was either irrelevant or changed to a "Water Committee " that became kind of a super committee of the village. But their focus remained water, rather than broad community development with a food security emphasis. Hilda Manzi, the SASOL representative on the evaluation team, who is from this Kitui area has spent a lot of her professional time in the area, states that broadly speaking the community identifies a problem, in this case, lack of water, and when that is addressed, the issue is closed. The people of rural Kitui tend not to see the water as an *opportunity/springboard* for further "investment", unless capacity development is systematically included to enhance the opportunity. Thus SASOL has had difficulty

gaining traction to move the community to the next stage of using the SD as a resource for other things to benefit the family/community. This was very much the finding in discussions with the focus group.

A systematic, *repetitive* regime for group management was not evident in discussions or in observation of outputs. The same was true in the implementation of the project management cycle, the *recurring* process of action, reflection, feedback, changes in action was not widely evident. Evidence of both activities was there but not in a manner that was *systematic*, *widespread and repetitive*. This is in part due to a lack of personnel/budget - and not a lack of skill or desire.

There is an appreciation of the visits made by Field Officers (mostly because this means that SASOL is still interested in them and they may get another SD).

**MAITO Self Help Group – A Model**

The last location visited was the home of a Self Help Group (SHG) called Maito, it was different in organizational structure and outlook although they also were quite highly vulnerable with a food security outlook similar to the other three locations visited. This organization is seen by SASOL and the team as a very viable model of a way of addressing some of the challenges/weaknesses seen in the other groups visited. The background to this group is that in the Yatta district there were five SHG's that were only marginally coping on their own.. In 2006-7 SASOL suggested to them that they consider combining forces, perhaps as a Community Based Organization (CBO) in order to leverage their position. They did, firstly as a larger SHG, and assisted each other in building a combined total of 30 SD structures by 2010. However more importantly ,they saw organizational problems and took action to address them in the new group in a way that no other group has done.

First of all, they addressed the problem of membership. They set a flat rate of 2,000 KSH to join and 50 KSH to register. This has removed a huge barrier to joining. Once a member, there is a sliding scale of dividends depending on what you have invested in sweat equity, so if you have participated in building multiple dams your dividend is higher than someone who has only paid the entrance fee but not worked . There is an option for you to “purchase” sweat equity if you desire and be eligible for a fuller dividend but it is not required. This is laid out in a 24 page by-law that was seen.

Secondly, they deliberately went out to young professionals from their area, and got them to join, and become advisers to the group in technical and financial areas. It was these young professionals that after consultation with the group, advised them to apply for status as a co-operative rather than a Community Based Organization (CBO) as a lot of their goals were economic goals rather than strictly social sector type goals.

**MAITO Cooperative with 11 Sectors**

1. Agriculture
2. Water/sanitation
3. Livestock
4. Veterinary medical supplies
5. Forestry
6. Mechanical Engineering
7. Accounts
8. Marketing
9. Environment
10. Security
11. Future plans:
    hospitality, fish ponds, & greenhouses

Each of these sectors are already active or there is a rational plan on when, how, what, who will do it at the right time. They have already 64 active members that have each donated one goat and one chicken to the cooperative and so have jump started the cooperative into an income producing unit.

The MAITO leadership are working closely with the sub-chief and obtaining some benefits from that. They acknowledge SASOL's assistance in obtaining a major grant to build their centre where

we met. The subtext for most of the meeting was that they saw SASOL as a place for SDs and water. When asked directly, how they saw SASOL, there was additional wonderfully descriptive, complimentary language. They see SASOL as a “considerate friend”, “ a shield and a light” warning/protecting them of problems and lighting their path with knowledge. (These sentiments are genuine however the reality is SASOL is seen primarily as the water organization.) They are proud of their group (and rightly so). They say they are “happy” when they come together and it shows. It is a place where they say they are always learning, from each other (skills) and from visitors (ideas). They see the group as a source of income generation for now, and a place where “we want to register our children so that they can continue this SHG/Co-op'. (The registration as a co-op is underway).

While there is little doubt that SASOL was instrumental in assisting this group to be truly a group that will positively impact food security in the wider community, it was likely fortuitous for both parties that they came together, these are industrious, visionary people in this group and SASOL has been able to add value in several ways.

The Maito SHG has been written on extensively in this evaluation because it highlights the possibilities of what SASOL can do with their approach. Perhaps SASOL has to be more proactive rather than just allowing the community to develop after a SD is installed. A different lens is needed by the community to look beyond “just water”. They need the lens of income and food generation rather than the lens of “coping” . As one team member put it, “The Maito SHG community group stands out to be a case in point upon which other communities can learn and emulate in order to resolve their development constraints whilst moving from the dependency syndrome of expecting someone else to resolve their problems”.

**Lessons learned**

* In order to fully catalyze the community there needs to be an on-going renewal of the vision of the community along with plans, goals and milestones to keep the community engaged.
* Not all goals should be based on the assumption of rain & rain-fed agriculture.
* The value of scheduled, regular visits by field officers teaching and following up on agreed milestones.
* A cultural understanding of how the community views life, for example, is lack of water an issue to be solved and set aside *or* is this an opportunity, an investment. This makes a difference as to what happens next.
* Planning and conceptualization of possibilities *beyond water,* appears weak in three out of the four communities visited.

**Strengths**

Some of SASOL's visible strengths are outside of the terms of this evaluation. They are strong on academic study, research, raising international awareness, and engaging the international community. Via a Dutch sponsored ‘Exchange’ program, through which they are training young Dutch and Kenyan university students.

SASOL is to be commended on:

- engaging and involving various levels of government in their approach.
- bringing academic attention and rigor to the SD phenomenon.
- engaging young, energetic men and women to confront the problems of this region.

In addition, the following are strengths seen by the team as they visited the four communities looking at sand dams in light of food security.

**Food Security**

**Food security impact of *Sahelian Solutions Foundation (SASOL)* programme**

On the whole the SASOL programme (sand dams + training / accompaniment) shows a positive impact on household food security of its target populations.

In general, *SASOL's* approach (content and methodology) is affirmed. Feedback from communities visited was in all cases and respects very positive. As underlined in the *Rempel (2005)*[1] report, *SASOL* needs to continue working closely with farmers, identifying opportunities, and building capacity to emphasize in-house understandings of the farming systems of the area that demonstrate conservation and the careful utilization of scarce resources on a sustainable basis.

Some of those opportunities include capitalizing on the various grasses and trees that naturally occur, for example various beneficial grasses are plentiful and some haying is possible without having to wait for fodder grasses to mature.

**Access and expansion to sand dam benefits**
Over 700 dams have been built by SASOL and the team has only seen those in 4 communities. Because of the degree of success and potential for growth has been observed, it is recommended that SASOL continue so that a larger_percentage of the population have access to the technology of sand dams. Ultimately, some ultimate thresh hold in terms of water usage will need to be built into the *SASOL* strategic plan. However, it is noted that staffing is about peaked out in terms of how many more communities can be reached effectively with present number of staff. This needs to be supported by donors. *SASOL* is encouraged to seek ways and means of expanding the amount of land under irrigation – as well as involving more people in small-scale irrigation from each of the communities currently being served. There were concerns about the particular drip irrigation system being piloted in terms of scale and accessibility to women. This has been discussed with SASOL.

**Sand dams create expectations and nurture hope**
Sand dams have demonstrated their worth. The people of the *Ukambani* believe and have confidence in sand dams. There is the expectation that water will improve people's lives and that crop production will improve; that livestock will be watered; that gardens with vegetables and fruit trees will get much needed moisture.

Seasonal streams with sand dams hold water where there was none before. When the sand dams have water in their 'veins' people (esp. women) save time from the drudgery and hard work of traveling, sometimes great distances, to procure water.

**Crop Diversification**
*SASOL's* promotion of a diverse number of drought tolerant crops, as well as vegetable gardens & fruit trees, is has been successful, although at the time of the assessment, the volumes of drought tolerant crops being harvested was still very small. This is essentially a function of this intervention being a minor component within a larger programme of interventions, and 3 years of poor/failed rains.

More emphasis needs to be given to strategies that reduce household vulnerability. Crop diversification is generally accepted as a key strategy. A combination of drought tolerant crops, vegetable gardens and fruit tree cultivation are seen as an ideal way in addressing the problem.

**Embracing *'Low External Input Agriculture'*** [*'Farming God's Way FGW'*]

*Low external input agriculture (LEIA)* is currently being heavily promoted in many places of the continent as a viable alternative to the popular, “a green revolution for Africa (AGRA)” campaign. The farmers of the *Ukambani* are ideal candidates for the LEIA approach.

**Training – the key to changing attitudes and practice**
Since the 2005 *Rempel/Manzi* study report, *SASOL* has expanded its program by incorporating various events with the purpose of community capacity building and training, and these programs continue to evolve. Staffing is a limitation as to how much can be done but a review of the structure and methodology of training which was called for in the 2005 report bears repeating. The current listing of training and learning modules appear to be useful and appropriate and the efforts of the *Field Officers* seems to be paying off in terms of changes in farmers’ attitudes and practices. However, it appears that for these concepts and practices to be adopted on a widespread basis, more focused effort will be required.

**Changing consumption preference**
*SASOL* has been encouraging farmers to plant drought tolerant crops as an alternative to a maize dominant cropping system.

**Striking a balance between promoting agriculture production and income generation activities**
It is widely acknowledged that sand dam technology provides water and saves time. With these two variables affirmed the emphasis of MCC/CFGB’s support to *SASOL* is to focus more on household food security in general and on crop/food production in particular (the combined contribution of rain-fed agriculture and small-scale irrigation). However, there may be limited to how much production can be achieved. Hence, there appears to be a role for the promotion of ‘off-farm’ employment or income generation activities.

**Livestock**
Keeping animals is a good drought mitigation strategy for farmers, because they can be sold during periods of drought and the money can be used to buy food. The ability of goats to browse legume bushes gives them the ability to survive drought better than cows. As many farmers note this difference, the number of cows will decrease while the number of goats increases.
Some community members are planting fodder (Napier grass and Dolichos lab lab) along terraces.

**Trees**
Community members see the value of trees and are committed to planting many. Community members are also planting mango trees and paw paw plants. Paw paw can produce fruit 18 months after planting, while grafted mangoes may take up to three years to produce fruit. Fruit trees can contribute to food security and be used as a source of income for the community.

Planting of timber trees is increasing, particularly Melia volkensii. This species can move households from subsistence agriculture to sustainable livelihoods. It matures in 12 to fifteen years and produces high-value, termite resistant timber.

**Families Relations**
SASOL has empowered families by offering women seminars and workshops on hygiene, sanitation, and farming skills that have enabled families and communities to cultivate their lands with care and increase their produce for household consumption and even for sale.

SASOL is to be commended for bringing on board five female staff members to be part of the often challenging activities of the organization and giving them an equal role in the organization, thus setting an example to the communities of the contributions woman can make.

The effects of SASOL's activities are already being seen in a positive growth in the status and life pattern of women. Communities have increased the number of months and locations that water can be drawn. They have STARTED increasing the variety and nutritional content of meals. Family dynamics have improved with women being consulted more and children are attending school more regularly as well as helping more in the home.

**Community Organization**

An excellent strength seen in SASOL's food security approach is engagement with local government structures and institutions leading directly into the community - not by-passing them. Another strength is that SASOL has other programs that are complementary and are woven into the food security projects. There are student teams (one Dutch/one Kenyan) working in the community on ideas, research relevant to various sectors of science and business. This has provided a great pool of upcoming professionals from which SASOL has hired staff who already have a good understanding of their vision and methodology. SASOL is also developing a vocational and entrepreneurial skill training program that is aimed at the village level.

**Opportunities and Areas for Growth**

**Crop Production**

*SASOL* in consultation with farmers and relevant government ministries could carefully study the current farming system to identify where there might be opportunities and advantages in terms of a select number of crops and cropping practices. Perhaps one effective strategy in promoting the uptake of drought tolerant crops would be for *SASOL* to procure some small quantities of seed from quality suppliers and to distribute these seeds among 'progressive' farmers for demonstration AND seed multiplication purposes. Additionally, *SASOL*, together with a community such as MAITO SHG could enter into an agreement to establish a community managed seed bank.

*SASOL* has made some efforts in embracing LEIA. Concerning soil fertility, *SASOL* has promoted composting and use of animal manure. However, these concepts need much more focused attention and follow-up to ensure proper adoption. In terms of preserving soil moisture, *SASOL* staff would do well to look closely at some of the experiences CFGB partners in Zimbabwe, Zambia & Malawi where 'Farming God's Way' / conservation farming (FGW/CF) approaches to 'planting stations' and the application of mulches has become very successful. Attending the MCC hosted workshop in Arusha will perhaps be an important first step - followed by some intensive training-of-trainers and exposure visits to places such as Zimbabwe and Zambia. Given the *Ukambani* agro-climatic profile and the ordinary farmer's means, *SASOL* is highly encouraged to promote *low external input agriculture*. Currently, on the African continent there is a strong movement building-up around *conservation farming (CF)*. MCC/CFGB has been actively promoting *Farming God's Way* – which is a variation on CF. Assessment team visits with farmers, coupled with field observations suggests *SASOL* would be well served by incorporating a campaign-style promotion of FGW/CF into its implementation plan.

**Drought Resistant Crops – Opportunity for Growth**

Drought resistant crops are proving to be an important part of food security. However, the limited uptake of these crops and the small contribution they are making to household food security suggests that a more aggressive strategy is required. With the incentive of a small amount of free seed many farmers could be testing and adopting drought tolerant crops.

A powerful means of convincing people to adopt drought tolerant crops into their diet is to organize demonstrations on how to prepare tasty and nutritious dishes with these food grains. Given the importance of drought tolerant crops in the overall success of achieving household food security, SASOL's monitoring & evaluation should document its experience with drought tolerant crops – with special emphasis on the shift from a maize-based agriculture and diet (consumption) to a drought tolerant crop based agriculture (production).

**Opening marketing channels**

If income generation from crops being grown under irrigation is to be sustained, *SASOL* will probably need to consider some level of involvement in *'value chain market'* development. Identifying & promoting high value crops. Studying markets to obtain price information, identify supply/demand opportunities/gaps and contact prospective clients/buyers.

**Income generation**

As was evidenced during the assessment team's visits to *SASOL* operational areas, the frequency of droughts underscores the limits of crop production in terms of achieving the target of year-round food security. The question is, *'what is a realistic level of crop production under the agro-climatic conditions of the Ukambani?'* What is a realistic target in term of crops production contributing to household food security? Is the 5-year average of 6 months food self sufficiency sustainable? Or, perhaps 12 months/year household food security IS a realistic target. Looking at the case of the Kamale Vegetable Grower's Association, maybe the people of the *Ukambani* can even dream of large numbers of farmers consistently producing household self-sufficiency AND even generate significant surpluses for household income? This needs to be debated and tested.

In this debate, IF it is agreed that for some locations that a realistic level of crop production could not reach the desired target of 12 months food self-sufficiency then it becomes quite clear that other approaches and strategies need to be considered. In this scenario, *SASOL* is advised to explore 'off-farm' opportunities and *income generation activities* (IGAs). In the first instance, traditional IGAs could be closely looked at to see if there is more potential to exploit these. Examples are: basketry, wood carving, bee keeping… If these are seen as not viable, then other 'outside' ideas should be explored. *SASOL* already has a ready-made example. In the case of the MAITO self-help group, it appears that crop production alone will not achieve the target. However, a combination of crop production and IGA (basketry and wood carving) show some promising development in reaching the target of 12 month food self-sufficiency.

**FFW, a necessary response, but…**

For SASOL's FFW response, due to capacity constraints, it only targets people in the community that are members of the project. Based on previous experience, it is presumed that other people in the community are covered by the USAid funded NGOs. The distribution of food is periodically vetted in meetings convened by the 'District Steering Committee'. With two agencies distributing in the same sub-location, it is of paramount importance that there be a high level of coordination and mutual understanding between the two agencies.

Due to sheer necessity FFW has become a significant dimension of household food security. However, due to the chronic nature of food insecurity in the *Ukambani* there is an ever-present risk that FFW could create dependency (a form of institutionalize welfare). Hence, SASOL's FFW component needs to be regularly reviewed within the management, and perhaps also periodically put on the agenda of *SASOL* facilitated meetings with representatives of the communities. In order to avert the potential for the dependency syndrome taking hold, there is a need for *SASOL* to issue

**clear** messages on the terms and conditions for engaging in FFW – and to repeat those messages frequently with the communities.

It is recommended that *SASOL* monitor and report on annual basis the relative contribution of FFW to household food security and how this **hopefully** diminishes overtime as the sand dams come into production and the harvest from the drought tolerant crops take-on increased importance in the diet and production of the region.

**Livestock - Opportunities for growth:**
More farmers need to raise more fodder shrub legumes, and grasses. A good place to plant fodder shrub legumes is around the border of the *shamba*, where they can provide security and beauty, while providing fodder for animals. Napier grass needs to be planted near the sand dams and on each farmer's terraces. In the very hot dry areas, Dolichos lab lab needs to be planted on member's terraces. Many members are already doing this, but observation shows that many more could benefit from this simple technology. Indigenous grasses and Boma Rhodes grass can be cut and stored as hay for the dry season.

The farmer's animal rearing system is a disadvantage because in time of drought the large stock of animals, especially cows, are unable to cope and most of them die or are sold at very low prices. Therefore, capitalize on goats over cows for best survival rates in drought and cull and sell animals that might not survive the drought.

Poor storage of dry animal feeds such as maize stovers hence degradation of the nutritive value result in unhealthy animals.

**Trees - Opportunities for Growth**
In dry areas members need to plant more Melia volkensii which is very drought resistant, rather than some other species that will not do as well.

SASOL may want to help group members with pesticide for termite control, or at least give instructions on where to buy and how to apply it.

Some community members seem not to have the commitment to look after tree seedlings for the first two years. Some species of tree seedlings are being lost to termites.

**Family Relations - Opportunities for Growth**
SASOL should ensure that their communication strategies (trainings) are clear and are carried out in simple language to the communities. For instance the topic of hygiene and sanitation may not only be in the interest of some section of the community but many members of the community are familiar with matters pertaining to hygiene. SASOL should have a theme in their trainings which they emphasize, and also consider the length of time they dedicate to these trainings.
SASOL should take a stronger role with partner organizations who work in SASOL communities so that when the partner organization does not yield the expected results, SASOL will be able to mediate.

SASOL has not been yet been faced with conflicts from within or outside the community. This explains the reason why the organization is yet to develop a conflict resolution mechanism. SASOL should consider developing a robust conflict resolution mechanism so that the organization can be prepared in case a conflict situation arises. With the rich research and academic connection the

organization enjoys, it can develop a practical mechanism for both its staff and community members.

SASOL is an organization that is compassionate to the plight of the communities that it works with. And hence, rejecting opportunities that arise from other donors that SASOL feels will benefit the communities can be difficult. However, SASOL should be determined to only work with donor organizations which share SASOL's values and promote activities in the communities uniformly.

SASOL can consider referring to the new constitution where property rights are referred to and the provisions it offers women. Thus SASOL can use these provisions and educate the women in particular and the community as a whole of these new provisions to help communities settle their property disagreements such as in the case of *Kamale* community. This however must be carried out with caution and patience since some believes are deep in communities' cultures and will take a lot of time to change.

**Training - Opportunity for Growth**

SASOL has invested a lot of time and money to train the community members as trainers. Some of the communities that SASOL is working with have not yet been able to implement their training, such as in project management pertaining to financial accounting, and even the administration, compared with the trainings that the communities have received on matters pertaining hygiene and sanitation. Communities strongly associate their improving health to the hygiene and sanitation training that they have received from SASOL.

The absence of coordinated field visits by SASOL field officers with the at least the committee makes the achievement of SASOL's set goals and objectives in a particular community difficult.

'On-farm' demonstration plots hold the potential for being an effective means of communicating practical/applied examples of the concepts, techniques and crops that *SASOL* has determined to hold most potential for improving the environment and support sustainable livelihoods. Progressive communities/farmers should be targeted for focal points for learning and experience sharing.

Since a necessary dimension of effective training is interaction with the community, ideally persons who can be based in the area and serve several surrounding communities, both men & women, could be a more predominant feature of *SASOL's* menu of interventions. Such capacity building and training of the community as a high priority could have a high pay off in terms of adoption of new and viable solutions to difficulties being faced by these communities.

Recommended topics:

To be revisited because of poor adoption rates in the community:

- composting & compost pits
- collection/use of animal manure as fertilizer
- planting of grasses or shrubs/trees, crop rotation and use of mulches ["misonzo" maize stover and other crop residue]

Other considerations for training:

Training on animal management and different rearing systems, "buy low and sell high."

Expand training and demo plots on fodder legume shrubs and trees and their storage for use during the dry period.

Training on the use of indigenous grasses and Boma Rhodes grass for hay making and storage for the dry season. Include hay box technology.

Promote more drought-resistant trees which most community members believe grow wildly. Eg Melia volkensii, balanites aegyptica, tamarindus indica, acacia species.

Training on planting with long-term economics of the family finances in mind. Have a diversity of tree species to cater for the various family needs E.g. Paw paws produce food in 18 months, grafted mangos take 3 years, and some timber takes more than 15 years hence can be grown for pension after retirement. So depending on family ages and stages, each group member will have different needs. When the child is born, plant the timber for her school fees.

A quick scan of the training materials reveals that the content/topics are useful. However, *SASOL* needs to develop more training materials, both for the farmers and for the trainers. People delivering the training should have an in-depth understanding of the principle of adult learning.

Given the importance of the capacity building and training, coupled with the now considerable investment in time and resources, *SASOL* may wish to consider undertaking periodic assessments of the effectiveness and impact of the training program via *Knowledge, Attitude, Practice (KAP) surveys*.

**Opportunity for growth in the overall SASOL approach - A model**

The evaluation team noted a progressive improvement in the engagement and the leadership of the communities visited as the week progressed - with a quantum leap on the last day with the visit to Maito SHG. However Maito is just launching and we were not told of any other similar groups but perhaps they are the light at the end of the tunnel. As one team member commented, “for a community group to thrive sustainably; there is need for a driving force”. This driving force emanates from the communities ability to visualize beyond sand dam construction (beyond just the water itself) including the ability to understand one’s stake as group member and the value of empowering the committee towards community action.” This “driving force mechanism” is what has not yet been completely captured by SASOL.

This weakness in community leadership is not news to SASOL. They are aware of this and informed us that capacity building and moving communities up the ladder was a real challenge in our very first meeting with them before going to the field. The weak link in the current approach of SASOL is that while working hard, they still haven't found a consistent way to move the community past the provision of water, to the next level of effective *utilization* of the water in various ways. The current visits, with the exception of the last community did not show a consistent pattern of social organizational leadership at the committee level that was pro active but rather a communities marginally coping and seeing aid in one form or another as the only solution.

It is recommended that SASOL analyze the success and motivation of Maito SHG in order to replicate the energy, community spirit and method of addressing food security demonstrated.

**A new name**

One opportunity would be for SASOL to consider a slightly broader mandate for the community committee. If, for example, a Food Security Committee were established as the beginning, it would allow for sub-committees such as SD, Livestock, Agricultural Enhancement, Sanitation, Vocational Training etc. The SD sub-committee may well be the first one activated. This would encourage committees to continue and allow naturally for on-going growth and interaction with SASOL, aside from a provider of SDs.

**Research**

After the field days, the evaluation team spent time reviewing the Rempel report of 2005. For the most part there has been some progress on all of the Rempel recommendations; however it is also true that there is a considerable way to go on many of them. It may be a useful management tool for the Board and leadership to review the recommendations of that report and the recommendations from this evaluation, looking for similarities or patterns in common and consider

those. Many of the recommendations center on the need to be more proactive with community groups in terms of using recurring widespread training. This has implications for a training/personnel budget and it is recommended that, given a set of training objectives, backed by documented best practices which would give credence to the expected outcomes and impacts, funding should be given.

**Networking**

More co-ordination with other NGO's involved in FFW, terracing and other similar activities might be useful to all parties so as to have a consistent approach, awareness of plans and possibilities for cross pollination of ideas. The communities including the sub-chief should participate in those meetings.

**Summary of Recommendations**

Numerous specific recommendations are embedded in the two sections Strengths and Opportunities for Growth. Below are six broad recommendations under which most if not all of the smaller specific recommendations fall.

- **Change in methodology** of training.
  The primary recommendation for SASOL, which will increase effectiveness across all fronts, is a re-evaluation of the *methodology* of training given to SD communities. This has implications for increased staffing and budget and given a "best practice" detailed objective that funding support is also recommended.
  Parts of that best practice which are easily identified are:
  - adult learning techniques
  - repeated exposure to information by the same group.
  - open to all members of the community
  - trainings in areas of community interest related to food security and associated income generation.
  - "bite size" chunks of learnings – not huge amounts on several topics at once
  - demonstrated value of teachings ie preparation of tasty food made from drought tolerant crops.
  - Use Knowledge, Attitude and Practice (KAP) surveys to check if people are internalizing and using trainings.
- **Build a commitment** to the value of monitoring and evaluation throughout the organization and establish a strong monitoring and evaluation unit.
- **Use and promote** *Low External Input Agriculture* by
  - in depth staff training
  - campaign style roll out in all communities
- **Increase number** of people and area of land with access to SD's.
- Always keep in the forefront of staff and communities **the dangers of FFW** aside from absolute necessity and then use a coordinated approach with other NGO's.
- **Target tree, crop and fodder plantings** for nutrition and income (current and future).
- **Consider** starting the community committee with **a name that encourages diversification** and growth rather then one whose name is predicated on an activity that will be over or minimized within a year. In this way goals and visions for water, food security and other developments can be charted and monitored every year on an ongoing basis.

# ANNEXES

## ANNEX 1 Summary response to Guiding Question & Purpose statements.

**The main guiding question of this evaluation:**

*How has the quality of life changed (for better or worse) for the participating communities, with emphasis on the effect of sand dams on food security?*

The quality of life has improved marginally in the communities with sand dams that were visited partially due to the extreme drought for the last three years. The social organization has not yet realized its potential as an integrated overall community mobilization force in three of the four communities to address issues beyond attaining water for people and livestock.

### Conclusion with regard to addressing the purpose statements of the evaluation

**Purpose statements**

1. *To assess the overall outputs and resulting impacts of the Kenya Sand Dam intervention.*

It is reported that the construction of sand dam has enabled growing of vegetables and fruit trees during the dry season – and, all year-round for the areas where sand dams are 5 years and older. During a visit to a community with a cascade of dams (10 in number) that were constructed in 2000, it was evident that some small scale farming was taking place during the dry season. It was also evident that the sand dam water resources were over-stretched during this period because of two consecutive periods of poor rains, even though a few 10ft deep scoop holes on the river bed were still in use by some farmers. The farms close to the sand dams had also an added benefit of increased harvest due to the rising water tables. The consumption of some vegetables in most households was all year round, even though the food produced from the farms was not adequate to cater to all the household consumption needs. Most farmers were able to confirm that there was improved harvest compared to before sand dams, due to changes in farming practice introduced along with the sand dam. At the sites visited there were signs, pockets of change and improvement that give hope to a wider success when adequate rain comes to mature the dams.

2. *To assess the effectiveness of the Kenyan Sand Dam intervention towards addressing chronic food insecurity in the project communities.*

The majority of site visits were to dams built within the last 5 years. In those five years, three have been experiencing one of the worst droughts in the memory of these farmers. What was observed was a fairly consistent pattern of low and slow accumulation of sand behind the dam. The same pattern was noted by Rempel et al in 2005. It was not possible to see if those dams are now mature but it would be a good indicator. In the communities visited and likely others, food security based only on SDs and rain fed crops are not likely to generate full food security year over year. Perhaps 60-75% of the food needs can be met if rains are moderately regular. Other options on the income generation side need to be pushed harder.

3. *To assess the sustainability of these programs.*

A higher priority given to training, monitoring, and alternative income generation is needed in order to increase the sustainability of these programs. It is noted that the scale of the drip irrigation scheme offered by another organization may not be sustainable. Smaller simpler methods may be more likely to last.

4. *To provide insight into the efficiency and economy of supporting longer-term food security using the current methodology (Cost benefit analysis).*

SASOL is not set up at this time to contribute data for an exercise of this nature. Nor was it possible for the team to visit many individual HH. The layout here is one of houses scattered over a three hour range of walking, utilizing the water from whatever point has water. Most of the year

that can be the SD but when that runs dry, water comes from a river even further away. It also is not possible to apply the C/B of other locations to this location as the variables are quite different.

Lastly, it should be noted that there are no other alternatives that come anywhere close to being able to provide water for humans, animals, and farming in this region at this cost. There are likely improvements that can be made to the social mechanisms to increase the benefits of the water available from the SD if donors are willing to fund more staff and training.

5. *To provide insights into unintended consequences, strengths and challenges of current projects and provide recommendations for future programming.*

Within any household, food is acquired by what you produce, sell, income generation and “other”. In these communities a big part of that “other” has been food-for-work (FFW). If the rains fail in the next 6 weeks it will again be needed in many or all the SD communities. There are several organizations engaged in this activity and it needs to be coordinated. Until the dams are all full of sand and there are adequate continuing rains FFW is a reality.

A testament to the value of the current projects is that former residents, relatives that had left the area because they could not survive are returning from the urban centres to take up farming again. Not a lot, but enough to say that they see things as improving.

Ease in obtaining water is improving family and especially husband and wife relationships because of the extra time. On the other hand Maito is so busy with income generation and enjoy working at the centre they say there is a declining birth rate as there is no boredom time which used to lead to reproduction!! As well, they see the advantage to this decline.

6. *To assess the performance in terms of the quality of design (including technical evaluation of recharge, construction methods and water quality) of sand dam structures.*

The water Engineer was dropped from the evaluation team roster for various reasons. The team did do a visual inspection of most if not all SDs we visited. There were apparent technical issues seen on several dams that were being addressed by the SASOL technical team, which underscores the importance of periodic technical inspections.

## ANNEX 2 Literature/Information Review for MCC/CFGB evaluation of the sand dam.

This review assumes that the reader already has a basic understanding of sand dams. It is divided into topics for quick reference.

### Practical Basic Information about Sand Dams

International Groundwater Resources Assessment Centre
Generic information on many of the aspects of a sand dam from building to impacts.
http://www.igrac.net/publications/199

http://en.wikipedia.org/wiki/Sand_dam (interesting results Chart)

http://practicalaction.org/practicalanswers/product_info.php?products_id=60

http://www.appropedia.org/Sand_dams

### Technical Approaches and Information

Aerts,J, R Lasage, W Beets, H de Moel, G Mutiso, S Mutiso and A de Vries. (2007) Robustness of Sand Storage Dams under Climate Change, *Vadose Zone Journa*l; August 2007; v. 6; no. 3; p. 572-580; DOI: 10.2136/vzj2006.0097 Soil Science Society of America
A later article by Aerts, Lasage, Beets, de Moel, Mutiso, Mutiso and de Vries looked at sand dams with future climate change of increased average annual temperature and decreased rainfall and predicts more of an effect on downstream water under these conditions.

Borst L. & S.A. de Haas, 2006 *Hydrology of Sand Storage Dams, A case study in the Kiindu catchment, Kitui District, Kenya*
The first component of the “Recharge Techniques and Water Conservation in East Africa - “Up-scaling and Dissemination of the good practices with the Kitui sand storage dams” project. This project of the Acacia Institute and SASOL aims at using the experiences of the sand storage dams in Kitui to upscale the construction of sand storage dams in other regions. Since little is known about the hydrological processes around sand storage dams, this first component focuses on the hydrology of sand storage dams.

Gijsbertsen, C. (2007). *A study to up-scaling of the principle and sediment (transport) processes behind sand storage dams,* Kitui District, Kenya. Master's Thesis. Vrije University, Acacia Institute.
A study which shows that a sand bed up stream from the dam has a positive effect on the working of the dam and the converse being true also.
http://www.sanddam.org/node/11
[A comparative study by A. van Loon and P. Droogers for SASOL Foundation (Kitui, Kenya) in 2006 showed that there is currently little effect by sand dams on downstream water. A 1- 3% reduction on down stream flow is the range currently postulated.]

Janzen, Jasper, (2007). *The influence of sand dams on rainfall-runoff response and water availability in the semi-arid Kiindu catchment, Kitui District, Kenya.* Master's Thesis. Vrije University. Acacia Institute, Solutions in Groundwater.
A hydrological study looking at building sand dams in locations other than Kitui.
http://www.sanddam.org/sites/default/files/Jansen%20-%202007%20-%20The%20influence%20of220sand%20dams%20on%20rainfall-runoff%20response%20and%20water%20availability%20in%20the%20semi-arid%20Kiindu%20catchment,%20Kitui%20District,%20Kenya_0.pdf

Lasage, Ralph. (2007) *A multi criteria analysis of water management strategies in Kitui, Kenya*.
Institute for Environmental Studies
A cost benefits analysis of increasing the number of dams in the Kitui area. They conclude

that doubling the number of dams could only be a good thing. Although the conclusion may be true, the study seems a little simplistic http://www.futurewater.nl/watmansup/downloads/2007_Lasage_MCAKenya.pdf

Orient Quilis, Rosa. (2007). *Modeling sand storage dams systems in seasonal rivers in arid regions: Application to Kitui district (Kenya),* TU Delft & UNESCO- IHE.

Orient Quilis, Rosa, Merel Hoogmoed, Maurits Ertsen,Jan Willem Foppen, Rolf Hut, Arjen de Vries. (2009). Measuring and modeling hydrological processes of sand-storage dams on different spatial scales. *Physics and Chemistry of the Earth* 34 28998.

Compares single vs multiple Sand dams in Kenya. Showed that if dams are built to close together, they act together and hold less water than two separate dams. www.rainfoundation.org/fileadmin/PublicSite/Manuals/Measuring_and_modeling _hydrological_processes_of_sand-stirage_dams_on_different_spatial_scales.pdf

*Re-hydrating the Earth.* European Union Knowledge Unit (SASOL 2002)

A multi organizational proposal for presentation to the European Union Knowledge Unit. The objective of this undertaking was to study water conservation techniques together with community organization within the larger ecological context, with the objective of bringing this distilled knowledge to the attention of the European Union. Sand dams were central to this undertaking.

For more technical papers see:
Sand Storage Dam References (UC) http://www.sanddam.org/node/11

**Partner or reference to Partners**

*Community Participation SASOL (2006)*

Partners and associated researchers have different ideas about what community organizing means within the SASOL context., This important, in house document was prepared to state SASOL's approach to community development as part of its long-term mandate.

Mutiso, C. G., Miller, H, (1986). *Sand Dams in Ukambani.* History of the Utooni Development Organization (UDO).

Mutiso, Sam. *The Significance Of Subsurface Water Storage In Kenya* (2002)

Ground water storage functioned in the realm of hydrology rather then in the realm of water engineering with its preoccupation with water distribution. This document provides a detailed review of water harvesting technologies in Kenya and their potential for future expansion.

http://siteresources.worldbank.org/INTWRD/Resources/GWMATE_Final_booklet.pdf

Nzomo Munyao, Julius, Joseph Muinde Munywoki, Mathew Ikuthu Kitema, David Ngui Kithuku, Joseph Mutinda Munguti and Sammy Mutiso. (2004). *Kitui Sand Dams: Construction And Operation*

This very important SASOL document is detailed, and based on actual field experience of ten years. It also expanded the frontiers of sand dam hydrology.

Odhiambo, Christian. *Sahelian Solutions (SASOL) Kitui Water Retention Sand Dams Project'*s.

An evaluation by DFID of SASOL dams. Clarifying the theory and assumptions underlying SASOL work. (No date given)

*Sand Dams in Kitui District, Kenya*

A quick overview of sand storage dams to improve rural livelihoods in Kitui District, Kenya http://www.sanddam.org/node/74

Thomas, D.B. *Where there is no water* (SASOL document)

Seminal Work on moving SASOL into the area of water

**Cost Benefit Analysis**

R. Lasage, J. Aerts, G.-C.M. Mutiso and A. de Vries. (2007). Potential for community based adaptation to droughts: Sand dams in Kitui, Kenya. *Physics and Chemistry of the Earth*, Vol 33. Issues 1 & 2. 2008, Pages 67-73

http://www.rainfoundation.org/fileadmin/PublicSite/Manuals/Potential_for_community_based_adaptation_to_droughts_-_Sand_dams_in_Kitui__Kenya.pdf

This article is mentioned earlier. It is also mentioned here because it is one of the few articles that looks at economic indicators. Its one conclusion is that the average income of farmers living near dams rose with 60%.

**Social/Organizational Approach to Sand Dams**

Haysom, Alexia. (2006). *A study of the factors affecting sustainability of rural water supplies in Tanzania.* , Cranfield University, Silsoe Institute of Water and the Environment

This study was commissioned by WaterAid to explore the reasons behind non-functionality of distribution points in central Tanzania. The research was initiated after a water point survey revealed average functionality rates among public distribution points of just 45%. Low rates of functionality haunt development practitioners the world over, despite the use of technologies and social strategies purported to increase sustainability.

*Institutional Factors: Kitui Sand Dam Programme,* An In house document explaining SASOL's approach to development.

Maurits W. Ertsen, Bernard Biesbrouck, Leonie Postma, Maartje van Westerop. *Community organisation and participatory design of sand-storage dams in Kenya*

Focuses on SASOL Approach. Funded by EU appears to be written about 2002 - Identifies same general weakness as the Rempel MCC/CFGB report of 2005. The weakness are not with the dams but with developing and maintaining a strong social village ownership & related ownership/care protocol.

http://ocw.tudelft.nl/fileadmin/ocw/courses/CivilEngineeringinDevelopingCountries/res00035/!
70617065722065727473656e206d6f70616e2073657373696f6e2065736e7363.pdf

**Results/Influences of Sand Dams**

Ertsen, Maurits, Rolf Hut (2009). Two waterfalls do not hear each other. Sand-storage dams, science and sustainable development in Kenya, *Physics and Chemistry of the Earth* 34 142

This very recent article is well worth reading. It looks at both the technical aspects and at community use of sand dams, being very aware of the power differentials among users. It looks at some of the problems that may arise in implementing similar techniques on a larger scale in other regions in sub-Saharan Africa such as ownership, labor investments and siting. This paper discusses experiences in Kitui applying the dimensions of construction planning, hydrological scale and water use. Tensions between stakeholders planning the intervention and benefiting from it are discussed.

Lasage, R., J. Aertsa, G.-C.M. Mutiso and A. de Vries. (2008). Potential for community based adaptation to droughts: Sand dams in Kitui, Kenya. *Physics and Chemistry of the Earth*. 33: 673.

Research in the Kitui District in Kenya of 500 sand dams, developed over the last 10 years showed that the sand dams have a large impact on the local community. In 10 years time, more than 100,000 people had better access to water through a relative low cost measure. The increased water availability, especially during dry periods, resulted in higher farm yields. Increased crop diversity was also noted. The average income of farmers living near dams rose 60% (from farm, brick and basket manufacturing). The local downstream water

balance is marginally influenced as the sand dams store less than 3% of total yearly runoff.

Rempel, Henry, Charity Wanjiru Nyaga, Hilda Kalekye Manzi, Peter Gaff. (2005) *Water in the Sand: An Evaluation of SASOL Kitui Sand Dams Project* Available from SASOL Kenya, Mennonite Central Committee (FDMR) Canada, Canadian Foodgrains Bank.
A comprehensive socio-economic assessment of SASOL Foundations Kitui Sand Dams project. Used as a benchmark for the current study. Useful in highlighting the inherent difficulties with a committee approach to managing sand dams.

**Environmental Assessments – best practices.**

Montes,Jesse. (2008). *Community Environmental Assessment in Rural Kenya: decision making for a sustainable future.* Master's Thesis. Natural Resources Institute. University of Manitoba.
Community Environmental Assessment (CEA) involves the adaptation of traditional Environmental Impact Assessment (EIA) practice to include various approaches to development and needs to utilize more adaptive tools for involving the public and for facilitating the assessment of small local projects.
Outcomes were considered using transformative learning theory which looks at how adults learn. The research revealed that CEA participants learned new information and skills in regards to soil erosion, tree planting, and pipeline maintenance.

Eleven key points for consideration are outlined which highlight strategies that aim at improving community participation and learning. The recommendations include: using alternative community representatives to enter a community, minimize donor perception of the CEA team, establishing a price for the use of traditional knowledge, giving adequate notice to participants, inviting youth & women, obtaining a commitment from community participants to inform the larger public, application of learning methods to small group work, build political capabilities, ensure management capabilities, incorporate mitigation measures in funding requirements, and providing a pictographic representation of the CEA report.
http://umanitoba.ca/institutes/natural_resources/canadaresearchchair/thesis/Montes_J%20Masters%20Thesis%202008.pd

van Loon, A. and P. Droogers, (November 2006), *Water Evaluation and Planning System, Kitui-Kenya WatManSup Report* No. 2
This highly technical report portrays different management scenarios based on the volume of water available. The overall objective of this report is to demonstrate how the water allocation component of IWMSM, the WEAP tool, can be used to support water managers and policy makers on relatively small reservoirs in a developing country.
http://www.weap21.org/downloads/Kitui.pdf

## ANNEX 3 Impact & Outcome Review by Sand Dam evaluation team.

Project Goal

The goal is to advance the capacity of selected rural communities in Kitui district to obtain increased water supply as a means to a more diverse, expanded supply of food and to increased income earning opportunities.

Based on the assessment team's visit to 4 communities it appears that SASOL has indeed increased the water supply. However, due to the current drought the water supply is not year round in all communities. Hence, water supply is directly related to the general climatic conditions being experienced in the region. There is generally a more diverse supply of food available to the household. Food supply has improved, but is highly dependent on the performance of the rains. Improved water supply has improved food supply for household consumption – but has not (with one exception) translated into opportunities for income generation.

Project Outcomes

Consistent with the purpose set for the project, the outputs outlined above are expected to generate a set of outcomes in each of the 250 sand dam communities.

- an increased, sustainable supply of water within a community;

In communities with sand dams the water supply has increased. However, water supply is not sustainable (year round) - this is being impeded by the prolonged drought. Number of months/year of water supply varied from one community to the next.

- one or more organizations within a community that guide community initiatives to build on opportunities presented by an increased supply of water;

Yes, in a couple communities. But organizations are not strong and they still depend on support from SASOL. In most cases the water supply was limited mostly for household use – not being exploited for income generation.

- increased abilities, at the household and community levels, to manage the water supply, including an ability to maintain the quality of water obtained from ground sources;

At household level the improved water supply is being effectively used – especially for personal hygiene. Households are also using *'water guard'* (a locally purchased water disinfectant).

At community level – people are protecting the water supply (fencing & locked pump). There are questions about possible water contamination of well water due to large numbers of livestock wandering in the area outside the fence perimeter with animal waste.

- re-vegetation of the land controlled by the members of the community as a product of strategic planting of grasses, shrubs and trees as made possible by expanded water harvesting structures;

There was only limited evidence of re-vegetation taking place. Spontaneous efforts by community members engaging in re-vegetation was not witnessed. Communities are still depending on SASOL to initiate and lead.

- an increase in the supply of food available in the community, including an expanded range of foods available and an extension of the growing season after the rains;

There is most definitely an expanded range of food available (vegetables & fruit).
The increase in food supply is largely determined by the strength of the rainy season. The area is predominantly a rain-fed dependent farming system.

- reduced time, especially for women, required to fetch water, freeing community members to farm more intensively, prepare meals on a timely basis, pursue new and additional productive activities, spend more time with family members plus extended time for rest and leisure; and

In communities where water supply is year round, feedback indicates that women are enjoying reduced time for fetching water. However, there are cases in communities with sand dams where some women are still needing to walk 2-3 hr due to distance to the sand dam. Building

more sand dams in the community would remedy this situation.
With more time at their disposal women are indeed engaging in other economic activities. Women are reporting that they are better able to fulfill family and community obligations. Women are involved in children's school work. Familial relations have improved and they also have more time for rest & leisure.

- livestock that is healthier, more productive and less likely to die during periodic droughts.

With water more readily available and more plentiful livestock are healthier and more productive. As stated by one farmer, "… I am now able to water the oxen and plough on the same day".
There are some concerns about people's ability to withstand a severe drought (with minimal losses of livestock). Given the importance and the value of livestock, drought mitigation strategies are of critical importance.

Project Impacts
As a sand dam typically takes 2 to 5 years to mature and become fully productive, project impacts will be limited during the course of a five-year time frame of the project. Some community-level impacts, especially from project action early in the life of the project, may include:

In communities visited it appears that some sand dams may require 5-7 years to fully mature. The maturation process of a sand dam is determined by the strength and intensity of consecutive rainy seasons.

- reduced poverty and an expansion of food entitlements for community members in dry land areas;

The consensus among the evaluation team is that there is an appreciable increase in household ability to purchase assets & purchase food.
There are noted improvements in quality of construction of their houses. Children are attending school on a more consistent basis.
There is a general sense of improved well-being.
The community appears more self-confident and self-assured (esp women).

- increased food security at household and community levels as a product of increased crop and livestock production, an expanded ability to select and store quality planting seeds, and an expansion of the range of nutritional options;

For community members served by SASOL food security has improved. The evaluation team is not in a position to comment on the food security of the community as a whole. As stated above, food security varies from year-to-year. Communities are dependent on rain-fed agriculture.
Households are consuming more vegetables and more fruit. This translates into a more diversified diet over longer period of the year.
An expanded ability to select & store quality seed was not brought up in focus group conversations – nor did the team see this – with exception of MAITO SHG which had a cereal bank in the plans but could not realize this objective as the harvest was not sufficient to establish a cereal bank

- improvements in the nutritional status and the health of community members;

There are indications of improvement in the nutritional status and health of community members. This is largely attributed to the variety of foods being consumed. In meetings with the communities the people are reporting less incidence of disease and reduced malnutrition. Women are less stressed.
People are eating more in terms of quantity of food consumed as well as number of meals eaten/day. The exception being this time of year when people are needing to reduce intake due to the intensity of the drought.

- enhanced status for women within a community as a product of their full participation in project activities and an expansion of leadership roles open for women;

The enhanced status of women is generally affirmed. Women are enjoying more respect within the community. Men are cooperating more and acknowledging of women's roles – in the home

& in the larger community. Women are more consulted – men do not leave them behind. Women related to the evaluation team that they are more confident and self assured – improved self esteem.

- improved school attendance at the primary school for all children, but especially girls; and

Improved attendance in school is reported. One community reportedly had constructed a school building. Education for the children a priority.

- greater social stability within communities as new income earning opportunities emerge for young males and females, reducing the need for young males to emigrate from a community in search of employment.

Functioning sand dams offer a significant time saving. Hence there are options to engage in other activities. One such option is to engage in casual labour as a form of income generation. This applies more for men than for women.
With water available closer to home children are more likely to be attending classes fulltime. Educated children MAY lead to better paying jobs and income generation opportunities in the future.
The SASOL program has offered communities a better buffer against prolonged drought periods – however, people are still very vulnerable and living on the margin.
There are a couple cases of sand dams serving as an incentive for people who were working outside returning to their villages to take-up farming.

**ANNEX 4 Training Resources available and recommended**

There are numerous books available from MCC Kenya that have been printed in KyKamba for the Sand Dam projects. In addition and/or included in these books are Resources on the following topics.

- Proper Farm Management taught using Adult Learning Principles
- Tree planting. Using 2’ x 2’ x 2’ planting holes. Using manure. Using termite killer.
- Poultry keeping(handling poultry diseases)
- Mango tree training
- Mango grafting
- Planting and the value of Melia volkensii, Kenya Forestry has a good booklet and value sheet
- Vegetable Growing
- Low cost drip Irrigation
- Preparing for drought
- Terraces, Kenya Department of Ag. has a manual that has the required information on laying out terraces
- Drought Resistant Crops and trees
- Seed Preservation
- Seed Multiplication
- Zero grazing of Goats
- Zero grazing of Cows
- Bee keeping, maybe you will get KDC to do this
- Roles and Responsibilities of Officers and Committee Members of groups
- Group Conflict Resolution
- The A to Z of how groups should handle money
- Group Empowerment, Mission, Vision, Goal Setting and Evaluation