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Project:	Building sand dam programmes in southern Africa to improve water security (SG.005.15)
Location:	Matobo (Zimbabwe), Tete (Mozambique) and Swaziland
Timeframe:	March 2016 – February 2017
Grant:	£65,000
Agency:	Excellent Development Isle Of Man Ltd
Implementing Partners:	Dabane Trust (DT) and the Christian Council of Mozambique (CCM)

Introduction

Southern Africa's drylands are made up of a variety of geographies and cultures, but common to all regions is increasingly erratic and unreliable rainfall, leading to severe water scarcity and vulnerability to drought, especially for the rural poor. Water access is especially limited in the target regions for this project. In Matobo District (Zimbabwe), just 13% of households have access to a water source within 15 minutes, and in Tete Province (Mozambique), less than 5% of households have piped water.

The Isle of Man International Development Committee (IDC)'s grant was used to build sustainable sand dam programmes in southern Africa over 12 months. Implementing partners the Dabane Trust (DT) and the Christian Council of Mozambique (CCM) were supported to improve their sand dam building capacity, laying the groundwork to expand our southern Africa programme. Sand dams were built in both Mozambique and Zimbabwe, providing a sustainable year-round water source for three communities suffering from severe drought.

Aims & Objectives

The overall aim of this project was to significantly improve rural water supply and climate resilience, and alleviate poverty in southern Africa's marginalised drylands through scaling up the use of sand dams – a unique, multi-use rainwater harvesting solution designed to capture and store rainwater, making water available year round for rural communities.

The project's objectives were:

- Improved construction of sand dams in the target region
- Knowledge sharing through peer-learning exchanges with regional partners
- Collect water quality and sediment profiling evidence
- Feasibility study of sand dams in Matobo, Zimbabwe
- Improved water availability and quality for **2,890** people in Zimbabwe and Mozambique

These objectives were pursued in an effort to address the following Sustainable Development Goals (SDGs):

1. **SDG 6** – Ensure access to water and sanitation for all
2. **SDG15** – Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss
3. **SDG1** – End poverty in all its forms everywhere
4. **SDG2** - End hunger, achieve food security and improved nutrition and promote sustainable agriculture

Challenges to Implementation

The biggest challenge for this project was the recent rains in Zimbabwe. These were the heaviest in living memory, and the country has been besieged by torrential flooding, made worse by the passage of Tropical Cyclone Dineo. This lead to a necessary pause in construction at Nxele and Nyoka dam sites as dams can only be built when rains have subsided and rivers have run dry (since construction takes place over the riverbed itself). All expenditure for these

dams has been made (materials have been purchased and stored securely, and community labour is free), and construction will be completed once the rivers run dry again and DT can safely get back on site.

A further challenge was the serious cash shortages affecting Zimbabwe during the summer. This led many project participants to engage in food/cash for work schemes, making it difficult for communities to make their labour and material contribution to the project. Despite this, the communities in Matobo pulled together with the motivating influence of local leaders (who are very much in support of the project), and were still able to contribute what had been agreed, including **45m³ of stone** and **17,000 litres of water** for construction.

There were also some communication and reporting challenges associated with CCM due to the language barrier and their restricted capacity as a small organisation. We plan to use this learning and mitigate similar challenges in future by introducing standardised reporting templates for our partners.

Project Activities & Achievements

Together with our partners, we carried out the following activities and achieved the following outcomes:

Needs Analysis

Two visits to both CCM and DT took place by the Head of Programmes; one in February 2016, and one with our Executive Chairman in October 2016. This involved field visits to gain a better understanding of CCM's and DT's skills and confidence in dam designing, siting, and construction, as well as project management, including financial management and M&E. The January visit also focused on planning for this project, and agreeing timeframes for the activities and programmes for the learning visits.

Excellent's Chairman on a site visit with CCM in Mozambique

Our Executive Chairman and a consultant also visited DT in March 2017. A key purpose for this was to assess DT's potential for becoming a regional centre of excellence capable of supporting other organisations in southern Africa to adopt sand dams into their programmes. A SWOT analysis was conducted with the following results:

- Strengths: community engagement focus and practice, water abstraction from sand rivers using Rowa handpumps (which DT developed), water quality testing expertise
- Weaknesses: sand dam design and construction techniques need strengthening
- External opportunities: sharing experience and rolling out Rowa handpump technology across other organisations to improve water abstraction from seasonal rivers
- External threats: resources to support DT's journey to becoming a centre of excellence

Overall, the consultant found DT's ***"construction of sand dams very robust with no evidence of leakage"*.** He recommended that DT staff spend more time working alongside the ASDF dam team to refine their design and construction skills, and that a sand dam technical training is held in Zimbabwe which other southern Africa partners can attend.

During the last year, under the leadership of our Executive Chairman, we have been reviewing and refreshing our organisational strategy - a crucial piece of work for developing our southern Africa programme, of which this project is an integral part. During the October visit, our draft strategy was presented to both CCM and DT. This included a discussion about how the partners thought they fit into the strategy, how the broader southern Africa programme would fit into the overall strategy and opportunities for new partnerships; in addition to the planned development of DT as a regional centre of excellence capable of supporting other organisations in southern Africa to adopt sand dams into their programmes.

Knowledge Sharing and Technical Training

In July, five CCM staff spent four days with DT in Zimbabwe to share lessons, challenges and approaches in implementing sand dams. DT presented sessions on topics such as site surveying and sand dam design, and explained their community based approach and how they mainstream themes such as gender across all their work.

A member of the DT team presenting on their development model

CCM presented on their water and irrigation work, and noted the potential to learn from DT in terms of water abstraction systems, e.g. Rowa hand pumps, especially as the sand rivers in Tete (Mozambique) are similar to those found in Matobo.

CCM visited four existing sand dam sites, where project beneficiaries shared their experience of the construction process. CCM stated that they find community enthusiasm highest early on in such projects, but that this drops off as work progresses. DT shared that they experience this too and urged CCM to work with local leaders to resolve participation challenges. CCM also learnt about pump operation, service and maintenance from beneficiaries, and saw how pumps can be used for irrigation. CCM and DT then came together to design a sand dam, guided by local information provided by the community at Nyoka, one of the new sand dam sites.

A CCM team member trying out a Rowa pump at DT's research tower

The following week, eight DT staff travelled to CCM in Mozambique, visiting new sand dam sites, five existing sand dams and four farmer groups. Both organisations discussed construction issues and possible solutions, worked closely again to design a dam, and led more practicals and presentations to embed a thorough understanding of each other's approaches and methodologies. In September, CCM visited our strategic partner, the Africa Sand Dam Foundation (ASDF) in Kenya. They used this opportunity to enhance their skills and knowledge in dam siting, abstraction methods, shallow well construction, constructing series of dams and in project reporting.

A community member in Gwanda shows CCM how to use a Rowa handpump

Both DT and CCM reported that the visits had been fruitful, conducive to the exchange of ideas and learning and gave an opportunity to learn how people from different areas adapt to the effects of climate change and water challenges. We are confident that their shared learning is already contributing to the improved construction of sand dams in the region.

Dam designing at the Nyoka dam site

DT visiting farming activities at a dam site in Tete

The Isle of Man kindly granted us an extension to this project in order for us to carry out a visit to Swaziland in March 2017. The purpose of this was to undertake knowledge sharing activities. This was achieved through meetings with our Swazi partners, the United Nations Development Programme (UNDP) and the Government of Swaziland, and through site visits to dams built as part of our 2014 pilot programme in Swaziland.

Representatives from ED met with members of the UNDP and Swaziland's Department for Water Affairs (DWA). The DWA presented on the current status of sand dams in Swaziland, followed by discussions about the way forward. They stated that they would like to maintain relations and provide support as and when required. The UNDP were very positive about the impact of the pilot and would like to see more dams constructed in Swaziland. Sithembiso Hlatshwaki (UNDP Programme Specialist) reaffirmed the value of sand dams in arid parts of the county and commented, **"*Sand dams have found a place in meeting livelihoods and needs of communities*".** She also explained that up-scaling would be difficult for the government financially, but that there may be potential for sand dams in the Government's 'Biodiversity for Livelihoods Programme'.

Four of the dams from our Swaziland pilot programme were visited, all of which were found to be maturing well and filling with very good quality sand. Three of them (in Matsanjani, Ntjanini and Sidvokodvo) have completely filled with sand and are already providing water to local communities. It is fully expected that the remaining dam will fill next season. Water quality data was available for three of the dams, all of which showed low levels of faecal coliforms (harmful bacteria), as per World Health Organisation (WHO) standards.

Additionally, a number of potential sand dam road crossing sites were identified, which could present a significant opportunity for combined water and transport solutions in Swaziland. A number of recommendations were also made for future Swazi dams including the installation of shallow wells, the separation of cattle troughs from handpumps to ensure cleaner water, constructing dams in stages to limit siltation and placing a greater emphasis on community engagement.

Ntjanini Sand Dam (built in 2014) with regenerated surrounding vegetation

Visiting Sidvokodvo Sand Dam (built in 2014) which has filled with very good quality sand

These activities allowed us to re-engage with our Swazi partners (and establish relationships with their new team members) and assess the strengths and weaknesses in their sand dam building capacity. It also allowed us to determine what future support they need, and how they can learn from and build capacity in our other southern Africa partners in Mozambique and Zimbabwe. The learnings from these activities will facilitate improved construction of sand dams within the target region and enable best practice to be shared with regional partners.

Water Quality Testing

DT carried out water quality monitoring during CCM's learning visit in Zimbabwe, to allow them to train CCM on the methodology. This involved presentations as well as practical demonstrations on the process of bacteriological water quality testing including sampling, sterilisation of the filtration apparatus, sample preparation, analysis and the recording of results.

CCM reported that their understanding had improved, but that they needed further training as this is still a new technology to them. This request was addressed during the learning visit in Kenya, where a Del Agua water quality testing kit (bought for CCM by the project) was provided and further training was delivered. The pre-construction water quality tests at Nyoka showed that there are harmful contaminants in the river. Further water quality testing will take place at dam sites later in the year using Rowa handpumps. It is expected that once the dams mature, abstracted water will be much safer as sand will filter and protect water.

Sediment Profiling

Cranfield University was contracted to support this work, which included conducting an initial literature review into river flows and sediment, as well as designing the research methodology, providing technical support and analysing the results. DT also carried out Geographic Information Systems (GIS) mapping of potential dam sites to assess whether the topographical features of a site are likely to be suitable for effective sand dams.

Sediment samples were collected from three sites in Matobo District and six in Gwanda District. DT analysed these samples to determine the type of sediment, potential storage capacity and extraction potential of the sediment, to help estimate the potential water yield of sand dams that could be built there.

DT and ED staff collecting sediment samples

DT giving a sediment profiling demonstration

The purpose of this was to improve understanding of the sediment profile needed for an effective sand dam to aid better siting. The Gwanda dams were separated into 'Big', 'Small', 'Filled with Mud', 'Slow-filling' and 'Successful'. Initial results from this showed no obvious difference in terms of sediment profiles and relative success of the dam. Further analysis to break the sediment profiles into percentage of sediment types from silt to gravel, also showed no substantial difference. However, across all six dams the percentage of sediment seen better at retaining groundwater (gravel, very coarse sand and coarse sand) was overall quite high. There was also a variation in sediment at individual dams sites in both the height of each sample (strata) and the distance of the pits away from the dam wall. One theory is that the 'unsuccessful' dams have sediment closer to the surface that is less permeable (i.e. fine sand) than the 'successful' dams.

Results from the analysis of both the Matobo and Gwanda sites suggest that sediment in these areas has great storativity (i.e. water holding capacity).Further research would be very helpful, including analysis of GIS data to further assess the differences between successful and unsuccessful dams and examine the differences in land use, geology, and topography between the dams.

During CCM's visit to Zimbabwe, a practical demonstration was given on conducting sediment profiling, covering how to collect sand samples along riverbeds, prepare samples and analyse results. CCM highlighted that the type of sand at this site was generally similar to that found in most rivers in Tete. DT also gave a theoretical presentation on the topic to complement CCM's practical learning.

Feasibility Study of Sand Dams

Detailed sand dam feasibility studies were carried out in Matobo, Zimbabwe. Firstly, a desk study was done using maps and GIS (Geographic Information System) software to identify rivers in Matobo with potential for sand dams and sand abstraction. The study focused on medium sized rivers with a width ranging from 15-20m as these are cost efficient in terms of sand dam construction.

Working closely with local leadership, a physical assessment was then carried out at eight river sites to identify the best locations for sand dams.

DT probing to ascertain sand water storage potential

At each river site, GPS coordinates were recorded, the river gradient and the sand alluvium depth determined and environmental factors assessed. This allowed DT to produce a report on sand dam feasibility in the area, ultimately identifying two sites as the best options.

Improved Water Availability and Quality

This grant contributed to our wider Southern Africa programme which involved the building of one sand dam each in the Nyoka and Nxele communities in Matobo (benefitting approximately **700** people at Nyoka and **655** in Nxele) and one in the Changara District of Tete, benefitting approximately **2,350** people. We estimate a total **3,705** people will benefit from these new water sources.

Nyoka Sand Dam (Zimbabwe)

Construction of the Nyoka Sand Dam

Case Study – Impact on Women

Senelisiwe Nyoni (age 37) worked on the Nyoka sand dam. Her previous water source was a distant borehole which was unreliable during the dry season, but now things will change; **"We believe we will get more water year round from the dam... it will be easier and cleaner."**She told us of the impact she expects to see;**"I hope that the increased access to water and the income from cropping will improve his [her child's] chance of a going to a good school".**

Senelisiwe also told us how the dam construction was a rare and welcomed opportunity for women; **"It gives us an opportunity to talk about our daily lives and learn from each other. Even in the presence of men we discuss issues and learn more".** She also explained how construction is predominantly a male role in her culture, and how working together in constructing the sand dam was helping to break down gender barriers.

Women in the Wiriamo community in Mozambique will also benefit from their new sand dam. The current lack of water has an especially negative impact on women and children as it is their responsibility to travel long distances and endure long queues to fetch water, time that could be spent working or learning. Women in the community stated that prior to the construction of the dam they **"spend almost every day looking for at least 20 to 40 litres of water for domestic use".** This is an enormous burden that the new sand dam will relieve for the women of Wiriamo, freeing up hours per day to focus on other aspects of everyday life and commercial ventures now that they have a nearby water supply.

Nxele Sand Dam (Zimbabwe)

Construction of the Nxele Sand Dam

Case Study – Kingdom Ncube

Kingdom Ncube (age 28) worked on the Nxele sand dam. Before the dam, the nearest drinking water source was a borehole over 3km away from his home. Kingdom told us how he wants to establish vegetable gardens in his community but **"for now there are few gardens because of water problems and the dam that many use for gardens is an open dam but it is too far from us... 10km away from my home."** Now Kingdom is living within 1km of a clean water source – and will benefit from a major reduction in time and distance to collect water.

Kingdom told us of the community's plans for the new water source;**"employment is a problem and we will start building gardens using the water, many can benefit."**He also explained how this extra income would bring further benefits to the community;**"Many children are not going to school because they can't pay the fees, so even the income they will be getting can go to pay the school fees."**

Wiriamo Sand Dam (Mozambique)

Construction of the Wiriamo Sand Dam **The completed Wiriamo Sand Dam**

Sustainability of this project is rooted in community ownership; communities were involved in identifying their water needs, locating dam sites and providing materials and their own labour to construct the dams. Dams themselves are built to last 50+ years, with little or no maintenance cost, and recharge naturally. The embedding of sand dam building knowledge and skills in our partners throughout the project will also support sustainability.

The new Rowa hand pump at Wiriamo

All dams have been fitted with Rowa hand pumps (designed by DT) and well points to allow for safe water abstraction by local communities. DT have trained CCM and 31 community members in pump service and maintenance.

Frequently used in Zimbabwe, the Rowa hand pump installed on the Wiriamo dam is the first time this technology has been used in Mozambique. Research shows that Rowa hand pumps produce clean water free from disease and bacteria, meeting the World Health Organisation's guidelines to drinking water.

Case Study – The Wiriamo Sand Dam

The Wiriamo sand dam is located in Changara District. Unfortunately, Changara's dry climate makes it vulnerable to drought which causes food insecurity and livelihood crises for many. Most of the (average 650mm) rainfall each year arrives between December and February, leaving a long dry period – and severe water scarcity.

This lack of water has a negative impact on the whole community, but especially on women and children who are tasked with travelling huge distances every day to collect water. Women in the community stated that, prior to the dam, they **"spent almost every day looking for at least 20-40 litres of water for domestic use".** Their new sand dam will free up hours every day so that women can focus on other things, like farming, and children can spend more time at school.

Aside from domestic use, the community is also planning to use their improved water access for farming, so they can grow more to eat and sell. Previously, households were forced to **"reduce the number of meals per day from three to two"** due to poor agricultural production. The community told us that in recent years, water scarcity has been so severe that they have only been able to carry out one, rather than two, harvests per year, and that the quality of food grown has been much poorer than usual. They feel that addressing these issues is the biggest impact the dam will have, especially as the majority of the Wiriamo population are farmers.

Liaison with Local Authorities

Local authorities in both Tete and Matobo have been supportive of our partners' implementation of sand dams (granting the necessary permissions where applicable) as well as their plans to build more. Sand dams also fit with the both Mozambique's and Zimbabwe's national plans for development, as laid out in Mozambique's National Development Strategy 2015-2035 and Zimbabwe's Agenda for Sustainable Socio-Economic Transformation 2013-2018.

Monitoring, Evaluation and Risk

This project was monitored by ED through the assessment of monthly financial and progress reports (based on agreed metrics) from partners and through in-country visits. This allowed us to monitor outcomes and impact measures on an ongoing basis. Our strategic partner, the Africa Sand Dam Foundation (ASDF) monitored the construction period of the project.

Operational risks to this project included a lack of technical capacity in local partners, which could have led to poor siting, design and construction of sand dams. This was mitigated against through sand dam training and capacity building activities for partners throughout the project.

A financial risk was economic instability and/or inflation increasing project costs. To mitigate this, the budget was put together using local currencies (Mozambique and Kenya) and US Dollars (Zimbabwe) and we used the average exchange rates for each over the last calendar year. We monitored exchange rates throughout the project to understand if there were optimal times to transfer funds.

A further risk was the potential of political instability to hinder project implementation. Before agreeing to work with wither CCM or DT for this project, a full Political, Economic, Social, Technical, Legal and Environmental (PESTLE) analysis was conducted. ED maintains a neutral stand in politics and we keep updated with security issues in project countries, with emergency procedures in place to maximise safeguarding. Extended drought also posed a risk to the project as this can cause dams to fill more slowly and make it difficult for communities to dedicate time to project activities. To guard against this, consultations were carried out with communities to identify their preferred time for dam building, so as to minimise impact on their faming commitments.

What Next?

During the next rainy season, the three sand dams are expected to start harvesting water which the communities will be able to access through wells and pumps, greatly reducing the usual time spent and distance travelled to collect water. Within a few months, communities should be able to see positive effects on local plant life and be able to use their new water sources for irrigation as well as drinking water for themselves and their animals.

This project gave our partners an important opportunity to engage with and learn from one another as part of our ongoing Southern Africa sand dam programme. CCM plan to use their refined skills and knowledge in designing, siting and constructing sand dams to increase their output to 10 sand dams per year in Mozambique. DT are also planning to construct more sand dams and are looking to become the central point of expertise for delivering a wider southern Africa programme. Excellent Development is planning on expanding this programme into further countries in southern Africa, as well as consolidating our work in Mozambique, Zimbabwe and Swaziland and continuing to pioneer sand dams worldwide.

Project Expenditure

	Project Budget (Revised)		Actual Expenditure		Variance
One Sand Dam in Zimbabwe	**£**	**12,434**	**£**	**13,546**	£ (1,112)
Cement (550 x 50kg bags)	£	4,535	£	3,383	£1,152
Steel & barbed wire (16mm iron bars x33 and 800m rolls barbed wire x1)	£	285	£	207	£78
Shuttering (maintenance of steel shuttering)	£	123	£	201	£ (78)
Tools (Wheel barrows, shovels, pickaxes, hammers, stone hammers, water drums, digging demarcation strings)	£	392	£	952	£ (560)
Food for construction team (60 people, 20 days)	£	1,283	£	856	£427
Handpumps (x1)	£	1,152	£	1,103	£49
Local skilled labour (Zim. Dam Supervisor x1, Artisan x1, Assistant x1)	£	1,639	£	681	£958
Materials transport	£	1,222	£	4,461	£ (3,239)
Sand dam permit & registration (x1)	£	100	£	-	£100
Dam design & planning, inc. site clearing	£	1,703	£	1,703	£0
Needs Analysis & Programme Planning	**£**	**12,904**	**£**	**13,007**	£ (103)
Flight from London to Zimbabwe for consultant and ED Head of Programmes	£	3,800	£	5,655	£ (1,855)
Accommodation and food in Zimbabwe (2 people)	£	1,304	£	523	£781
Consultant fee (17 days including write up)	£	6,800	£	5,600	£1,200
Detailed programme planning and Inception Workshop	£	1,000	£	1,229	£ (229)
Water Quality Testing (in Mozambique and Zimbabwe)	**£**	**-**		0	£0
Data collection and analysis	£	-	£	-	£0
DelAgua testing kit (x1) and materials	£	-	£	-	£0
Training on collection methods	£	-	£	-	£0
Sediment Profiling	**£**	**9,692**	**£**	**9,526**	£166
Data collection and analysis	£	3,715	£	3,660	£55
Sediment shaker and sampling sieve set (x2)	£	2,256	£	2,256	£0
Training on sampling methods	£	2,521	£	2,466	£55
Technical modelling support	£	1,200	£	1,144	£56
Construction Support Provided by ASDF*	**£**	**2,658**	**£**	**1,703**	£955
Accommodation (65 nights)	£	820	£	557	£263
Labour (1 ASDF Dam Coordinator and 2 Fundis)	£	1,150	£	1,146	£4
ASDF technical support	£	688			£688
Participatory Learning & Training for Communities	**£**	**1,949**	**£**	**2,794**	£ (845)
Sand Dam Learning Visit to Kenya	**£**	**2,091**	**£**	**3,427**	£ (1,336)
Flights from Zimbabwe to Kenya	£	-	£	-	
Flights from Mozambique to Kenya	£	1,391	£	1,893	£ (502)
Participants' travel expenses	£	69	£	191	£ (122)
1 night accommodation in Nairobi for 2 people	£	131	£	293	£ (162)
1 week full board accomodation and local transport for 2 people in Kenya	£	500	£	1,050	£ (550)
Peer-Learning Visits Between Dabane Trust and CCM (2 visits: 4 people travelling from each partner + 1 person from Excellent Development)	**£**	**8,984**	**£**	**5,221**	£3,763
Accommodation and food for 1 week in Zim / Moz per person (x5 people, x2 visits)	£	4,562	£	2,751	£1,811
Travel between Zimbabwe and Mozambique (x4 people, x2 return visits)	£	522	£	1,139	£ (617)
Return Flight from London to Zimbabwe	£	1,900	£	1,331	£569
Return Flight from London to Mozambique	£	2,000	£	-	£2,000
Dabane & CCM Project Management & Fieldwork	**£**	**4,111**		**£4,193**	£ (82)
Monitoring, Evaluation, Finance & Administration	**£**	**7,329**	**£**	**7,329**	£0
Monitoring & Evaluation	£	3,036	£	3,036	£0
Finance & Admin Costs	£	1,641	£	1,641	£0
Audit	£	2,652	£	2,652	£0
Transport	**£**	**2,848**	**£**	**4,328**	£ (1,480)
Dabane Trust & CCM field transport	£	1,373	£	3,161	£ (1,788)
Motorbike hire for ASDF concultancy support	£	1,475	£	1,167	£308
Community Contribution	**£**	**6,215**	**£**	**6,215**	£0
TOTAL PROJECT COST	**£**	**71,215**	£	71,291	£ (76)
Less community contribution	£	(6,215)	£	(6,215)	
GRANT RECEIVED/SPENT	**£**	**65,000**	**£**	**65,076**	£ (76)

*Construction support was provided by Dabane Trust

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Thank You

We are extremely grateful to the Isle of Man International Development Committee for the generous grant which allowed this project to take place. Thank you on behalf of the beneficiaries, our local partners, and Excellent Development Isle of Man.

Report compiled by:
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