Evaluation of the short, medium and long term sustainability of Concern's WASH programme in the Kagera Region of north-west Tanzania

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Executive summary

This report summarises the findings from a two week field visit to the Kagera Region in north-west Tanzania during which 17 hand pump water points (WPs) installed by Concern and their local partners were evaluated with respect to the sustainability of the installed infrastructure, the water point user committee and backstopping support. Interviews were held with water point committees from all 17 WPs, in addition to the Concern WASH team based in Ngara, Concern's partners (TWESA and CBHCC) in the three Districts, District Engineers working for the Local Government as well as some local hardware shop owners.

The number of hand dug wells installed and committees set up in the region over the past 7 years by Concern's WASH programmes is impressive. The process by which communities were selected, their subsequent sensitisation and involvement with regards to the water point location and construction, and training of water point committees all seemed to be carefully thought out and well executed in general, with the aim to ensure the sustainability of the water points. In addition, the choice of Nira hand pump used for the programmes had been critically chosen to ensure that the technology would be robust, easy to maintain and have access to spare parts (being manufactured in Tanzania).

The overall sustainability of the different WPs has been characterised according to three fundamental criteria: the sustainability of the physical infrastructure, the sustainability of the water point committee and the sustainability of the backstopping support.

From the 17 WPs visited, only one was found not to be functioning due to a mechanical failure which had not been repaired since 2012. However, four other water points, although still functioning, were not being used by the local population due to complaints about the water smelling, not tasting good and also running dry during the dry season. In these cases the local population preferred to use nearby traditional unprotected sources. Users at six additional water points also complained that the yield from the wells reduced significantly during the dry season leading to long queues as people had to wait for the well to recharge. This does highlight the question as to whether such shallow hand-dug wells were the most appropriate technology for all of these sites. Poor water point design and installation will impact on the overall sustainability of the programme, particularly with regards to how often a pump will need to be maintained and also whether the water point is trusted by the community, both in terms of water quality and quantity (availability) throughout the year. There was a clear correlation between the sustainability indices of the water points and size of population served; the more in demand the water point the more likely it is to be maintained and valued by the community, in addition to the larger communities having a better financial capacity to fix problems. From this survey it would seem that a minimum user population of around 100 households would be an appropriate target to aim for per water point.

The water point committees do appear to be performing a crucial function in relation to the sustainability of the water points and the members on the committee seemed to be content with the voluntary nature of their roles. Some aspects of Concern's committee model, such as the frequency of meetings expected, the taking of minutes, the regular collection of funds, hadn't really been embraced and had started to slip after the first year. However, given that 16 out of the 17 water points were functioning, the modus operandi that had developed did seem to be working for most committees. For example, the practice whereby most committees collect money to pay for maintenance retrospectively after a breakdown

seemed to be effective. There does seem to be enough money in the local communities to react to any maintenance requirements if the water point is valued enough. It should also be recognised however, that for 8 out of the 17 water points no maintenance had been required to date since the installation / refurbishment of the water point as they were still relatively new and so, in a sense, the committees are relatively untested.

There didn't appear to be any targeted activities in any of the WASH programmes carried out by Concern or partners with respect to developing the supply chain for pump spare parts or mechanical expertise outside of the water point committees. It seemed to be assumed that the Local Government Water Department would perform the critical link in the supply chain between the pump manufacturers and the water committees. However, the District Water Departments did not appear to be resourced adequately enough to carry out this role for the number of water points that had been set up. As discussed above, the water point committees do seem to have the economic capacity in their communities to pay for maintenance and so maybe some additional work to analyse and target appropriate interventions in the supply chain would help to ensure the sustainability of the programmes.

Finally, the overall community engagement strategy and participation throughout the process of siting, installation of hand dug wells and setting up of the committees definitely seemed to have engendered a sense of ownership of the infrastructure which was heartening. In response to the first question put to the users, "*Who owns the water point?*", every group of users answered without hesitation something to the effect, "*We do! It's our communal property!*".

1.0 Introduction

This report summarises the findings from a two week field visit to the Kagera Region in north-west Tanzania during which 17 hand pump water points (WPs) installed by Concern and their local partners were evaluated with respect to the sustainability of the installed infrastructure, the water point user committee and backstopping support. Interviews were held with water point committees from all 17 WPs, in addition to the Concern WASH team based in Ngara, Concern's partners (TWESA and CBHCC) in the three Districts, District Engineers working for the Local Government as well as some local hardware shop owners.

Concern started their first WASH activities in this region based in the Ngara and Biharamulo Districts with the *Water and Environmental Health Programme* (WEHP) which ran from 2007 to 2011. This programme consisted of installing water points with hand pumps, protected springs, sanitation in schools with rainwater harvesting, some household supply of sanitation slabs, as well as a pilot solar pumping project.

Another source of funding for WASH activities was then gained, the *Water Facility* (from EU funding) which ran from 2012 to 2013 which included similar activities again in the Ngara and Biharamulo districts but this time also included activities in the Kibondo district. In addition to hand pumps, protected springs, sanitation in schools with rainwater harvesting etc., this programme also included 5 solar pumping projects.

Finally, WASH activities are currently being carried out via project, now known as the *WASH Programme*, which is funded by Charity Water (a US source of funding) which started in 2012 in parallel to the Water Facility programme and will end at the end of January 2014.

2.0 Methodology

Over the last 10 years Concern with their local partners have constructed 775 water points of different types including shallow hand-dug wells, protected springs, gravity distribution schemes and solar pumping schemes, as summarised in Table 1. For this assessment it was decided to focus on the shallow hand-dug wells (of which 580 have been installed) due to the relatively low number of water points that could be visited during the assessment, given that comparisons needed to be made between the three different districts (Ngara, Kibondo and Biharamulo) as well as three different age groups of the water points (<2 years, 2-5 years and >5 years). Table 2 summarises the statistics of the hand-dug wells between the different Districts and different age groups. As the total number of water points that could have been feasibly visited was 17, an ideal distribution of hand dug wells between the different Districts and different age groups was derived, as shown on Table 3.

It should be noted that in Tanzania, a District is formed of 100 to 200 villages, with a Ward then consisting of 5 to 6 villages. Villages (which have a population of a few thousand people) are then subdivided into sub-villages which is typically the level at which each installed water point was targeted to serve.

Table 1. Summary of water points constructed during each time frame according to type, and district.

<2 years old

	Total	Biharamulo	Ngara	Kibondo
S/Well	**132**	64	11	57
Spring	**81**	3	24	54
Borehole	**21**	-	-	21
Gravity	**15**	-	-	15
Other (DP etc)	**10**	6	4	-
Total	**259**	67	35	132

2-5 years old

	Total	Biharamulo	Ngara	Kibondo
S/Well	**285**	181	80	24
Spring	**136**	27	97	12
Tank	**1**	1	-	-
Total	**422**	209	177	36

>5 years old

	Total	Biharamulo	Ngara	Kibondo
S/Well	**63**	19	44	-
Spring	**25**	8	17	-
Borehole	**1**	1	-	-
Other (DP & RWHT)	**5**	4	2	-
Total	**94**	32	63	-

Table 2. Summary of shallow wells with hand pumps constructed during each time frame according to type, and district.

age	**Total**	**Biharamulo**	**Ngara**	**Kibondo**
<2 years	**132**	64	11	57
2-5 yrs	**285**	181	80	24
>5 yrs	**63**	19	44	0

Table 3. Suggested breakdown of number of hand pumps to visit during assessment per district.

Age	**Biharamulo**	**Ngara**	**Kibondo**
<2 years	2	0	3
2-5 yrs	3	2	1
>5 yrs	2	4	0
no. per region	*7*	*6*	*4*

A number of WPs from each District of different age groups according to Table 3 were then randomly selected and sent to the WASH team in Ngara to determine whether they would be logistically possible to visit during the time frame for the visit: a couple of WPs were

deemed to be inaccessible during the rainy season and so replacement WPs were found of the same age and region. The final schedule for the WP visits is contained in Appendix A.

The format of the interviews for each sub-village water point was as follows. On entering the village, one or two village facilitators were met and then we headed to the water point first to carry out a visual assessment, measurement of the pumped yield and in some cases (PE 15, 16 and 17) dismantled the pump for evaluation and cleaning. The visual assessment included an assessment of the condition of the protective slab, whether there was a fence or not, the siting of the water point with regards to any nearby sources of pollution (houses and/or agriculture) as well as protection of the water point from rainwater runoff. We then met members of the water point user committee to begin the interview as per the questionnaire in Appendix B. A minimum of three and maximum of 8 members attended these interviews depending on other demands on their time. It should be noted that this assessment was carried out in the rainy season which is traditionally a very busy time in the fields for most inhabitants of the villages in that region. At the end of the water use committee's questionnaire several water point users were then brought in and a different questionnaire asked of them (see Appendix C). Each visit usually took 3 to 4 hours.

Throughout these interviews Saad Makwali (Concern's Environmental Health Officer) provided the translation as well as giving the committee and users much advice and feedback during each session. At the end of the interviews the committee and users were asked if they had questions and these were discussed at some length with feedback given.

Interviews were also held with the Concern WASH team in Ngara with the questionnaire included in Appendix D. The same questionnaire interview was also held with TWESA (Tanzania Water and Environmental Sanitation), the local partner for the WASH programme in the Ngara and Kibondo Districts and CBHCC (Community Based Health Care Council), the local partner in the Biharamulo District. In addition, meetings were arranged with the Local Government District Water Engineers in Ngara and Biharamulo. Finally, some short interviews were held with hardware shop suppliers in Ngara in order to assess whether pump spare parts could be sourced locally.

3.0 Results of survey

3.1 Interview with Concern and local partners

Overview of WASH programme

Concern and their local partners have a Memorandum of Understanding with the Local Government who are invited to take part at all key decision stages regarding the installation of new (or rehabilitation of existing) water points. Once the location of a new water point has been broadly decided upon (see later), the partner (TWESA or CBHCC) carries out an initial community sensitisation. When the local community are ready / in agreement to work with the programme, they are then helped to set up a water point committee which is trained by the partner (see later). In parallel to this the community have to agree to share in some of the costs associated with the infrastructure and as such they provide labour to dig the well. The casting of the concrete well rings and slab is carried out by the partners and these are then transported to the village. Concern purchases the pumps centrally from Dar Es Salaam and then transports them to site. Concern and partner then install the pump and finish off the protective apron. The local community are then finally responsible for constructing the fence.

Location of water points

For the first WEHP programme an extensive access to water point profile was carried out for the Ngara and Biharamulo Districts which was then compared with the National Water Policy in terms of access to water points, particularly with regards to population and distance. This exercise allowed different communities to be prioritised with regards to the need for new or refurbished water points. Meetings were then initiated with the respective communities during which a consensus was reached between Concern and local partners and the community as to where the water point should be sited. A feasibility study of the water source was then carried out by the local partner by augering a hole down to 6 m depth to take a water quality sample and also calculate the potential yield. The technical assessment of the yield was carried out in the dry season using a “jolly jumper” manual pump, as shown in Figure 1. This pump was inserted down the augured hole and continually operated manually for one hour during which time the total quantity of water discharged was measured. If this discharge was greater than 500 litres in the hour then the site was deemed to be suitable for a 6 m hand dug well; if less than 500 litres then an alternative site was sought. The standard design was for all wells appeared to be a 6 m deep hand dug well (or less if bedrock is hit at a shallower depth). This design did not seem to vary depending on parameters such as the level of water table or the expected number of users of the water point. Pre-cast concrete rings of 1.5 m diameter were used to support the side walls as the wells were dug. The concrete apron was cast in situ and was generally about 5 m diameter.

An initial sample of water was taken from the augered hole for chemical and microbiological water quality parameter analysis. Another sample was then taken after the construction was complete and the well had been disinfected. Subsequent water samples from each well were apparently taken every month until the end of each respective programme for each water point. However, it was difficult to determine how water quality changed over time from the central spreadsheet database of results kept in the Concern Ngara office as new results were over written on top of the older results each time a new sample was taken. The

original results from each sampling trip were stored on paper at another location outside of town but were not reviewed during the trip.

Figure 1. Jolly jumper used to assess potential yield.

Choice of pump technology and supply chain

As discussed above, before the WEHP programme commenced, an existing water point profile was carried out in Ngara and Biharamulo Districts which included both the location of the water points and the type of pumps being used as well as their performance over the years. The results of this exercise led the Concern WASH team to decide not to install new India MkII or Afridev pumps (as existing pumps had proved to be problematic in the region with spare parts hard to source), but to install new Nira hand pumps as shallow wells (see Box below). The reason for choosing this pump technology was that they are manufactured in Tanzania, other experiences with them in the region as well as other areas of Tanzania had been positive to date, maintenance requirements are low in addition to requiring few spare parts being required, as well as the fact that they are easy for children to use. It should also be noted that in addition to providing new water points, part of the WEHP programme was to rehabilitate existing water points most of which were bored wells with India MkII and Afridev pumps. It is not clear why shallow hand dug wells were chosen as the preferred option for all new hand pump water points in all three programmes, as opposed to bored wells for example, although obviously hand dug wells are a lot cheaper and quicker to install than bored wells and so more WPs can be installed for the same programme budget.

Nira AF-85 hand pumps are direct action pumps developed by a company based in Finland. However, the Nira AF-85 pumps are manufactured in Dar Es Salaam (Tanzania) and Accra (Ghana): in Tanzania they are sometimes known as Tanira AF-85 pumps. They are designed for shallow lift (<15 m) applications. These pumps are classed as proprietary hand pumps by the Rural Water Supply Network. Simple tools are needed to pull out the entire pumping element as well as the foot valve and rising main. The assembly is corrosion resistant and very lightweight.

No explicit activities were carried out to develop / stimulate a supply chain for spare parts for the Nira pumps although a funding proposal was recently sent to the Scottish government to include such activities in relation to the overall WASH programme; unfortunately this proposal was recently rejected.

Costs of infrastructure

The total cost for each **hand-dug shallow well** has been approximately 3.5 million Tsh.

Each Nira hand pumps cost 1.2 million Tsh and these were all sourced directly from the factory in Dar Es Salaam. This cost includes the provision of a maintenance tool kit which comes with each new pump. The WASH team did not know the costs of spare parts separately.

For the **rehabilitated bored wells**, the average total cost per borehole was 1.5 million Tsh (including cement and aggregate). The India MkII pump parts cost:

- 600 000 Tsh for the pump head
- 7 000 Tsh for a riser pipe (ave. 15 needed)
- 10 000 for a riser rod (ave. 15 needed)
- 300 000 for a pump cylinder

There was no information on how much it would cost to drill a new bored well and install a hand pump in this area.

Training of Water Point Committees

Each committee was set up with 8 people, with a gender balance of 4 females and 4 males. The roles are as follows:

Chairperson / Secretary / Cashier / Pump caretaker
Health Member / Health Member / Member / Member

The Chairperson, Secretary, Cashier and two members should then receive a 3 day training session on management and finance. In parallel to this the two health members receive separate hygiene and health training whilst the pump caretaker gets a separate 2 day training session - one day on theory followed by a one day practical where a pump is dismantled and re-assembled.

The committee are expected to promote health and hygiene as part of their role in the community. When the first WASH programme started off for the WEHP programme, health and hygiene were promoted using the PHAST methodology. However, during the EU Water Facility Programme elements of CLTS were also added to develop a merged approach known as CLHAS (community led health and sanitation).

For each water point, Concern and local partner have been monitoring the progress of each committee until the end of each respective programme. These results are shared with the Local Government at monthly meetings. Results are also then shared between the 3 Districts at quarterly meetings.

Backstopping

The Local Government takes responsibility for the water points once the respective funding programmes finish. The District Water Engineer must approve each water point when it is

handed over at which point Concern (and local partners) should send details of the installed infrastructure (pump type, well depth etc.) to the Local Government.

Sustainability of WASH Programme

During discussions with the Concern WASH team it was clear that they considered the length of the two more recent WASH programmes (the *Water Facility* and ongoing *WASH Programme*) to be a problem with regards to the longer term sustainability of the water points. In these programmes only one year had been allocated per water point during which everything had to be completed, i.e. planning, community training, construction and installation and post-installation monitoring. So, for most water points this just left 3 months post installation support which was not considered to be satisfactory. They consider that ideally support and refresher training should be available for at least 12 months to 18 months post completion.

3.2 Interviews with Local Government – District Engineers

The interviews with the District Engineer representatives of the Local Government in Ngara and Kibondo revealed that they have been involved at all stages of the WASH programmes with Concern and TWESA from initial site selection, water committee training, pump installation and post-installation monitoring. Monthly meetings have been held with Concern throughout the programmes. They confirmed that once Concern finish their programme at each water point then the community should contact the Local Government District Engineer if there is a problem. They will then send a technician to assess the problem as soon as possible, but did point out that due to logistical constraints (such as only having one vehicle per department) it could take 2 to 3 months on average before a visit is possible. The Local Government have a policy whereby the community should pay for 20% of any spare parts cost for replacement of a large item. However, if the required repair is minor in nature (for example, replacing a worn seal), then the Local Government will charge the community the full cost. Typically the community must also pay the costs for transport and subsistence for an engineer to visit their site as detailed later.

Another interesting finding from these interviews was that the water engineers in Local Government did not seem to know the cost of spare parts for pumps as they do not get directly involved in financial transactions. When spare parts or new pumps are needed, the Engineering Department must go through a central government procurement process in order to source such parts from suppliers in Mwanza. This procurement process can add considerable additional delays, up to a few months. The District Engineer confirmed that in their experience they have found that the India MkII pumps generate more maintenance problems than the Nira hand pumps.

The Local Government's overall impression of Concern's WASH programme in the region is that 80% of Concern's infrastructure is very good and remains sustainable for long periods. They see particular challenges in the mountainous areas where the community tend to live on the high ridges but the water points are sited down it the valleys, in some cases 200 to 300 m lower in altitude. In such situations they would prefer to see more investment in solar pumping schemes to save the local population both time and effort by not needing to carry water back up steep hills to their houses.

3.3 Visits to Water Points and Interviews with Water Committees and Users

Table 4 summarises the physical indicators for the 17 different hand-pumps visited with 6 of the evaluated WPs in Ngara, 4 in Kibondo and 7 in Biharamulo districts. The ages of the water points were not exactly as per the desired distribution shown in Table 3 due to some discrepancy between the date which was recorded on the summary spreadsheets and the actual date of installation, but nevertheless were fairly close. Table E.1 in Appendix E shows the water points ranked by age since installation / refurbishment by Concern.

Table 4. Water point physical indicators.

Site no.	Water Point Name	Age *	Population † (households)	Pump type	Yield † (l/min)	No. strokes to get water	Ave. water use ‡ (Lcd)
PE1	**Ngara** – Murukukumba (Mukibande)	2.0 yrs	120 (24)	Nira	28	6	12.4
PE2	**Ngara** – Bukiriro (Kwa Mdogo)	9.6 yrs	233 (57)	Nira	n/a	n/a	13.2
PE3	**Ngara** – Bukiriro (Mukiyange)	2.3 yrs	390 (83)	Nira	20	4	11.4
PE4	**Ngara** – Bukiriro (Kisima B)	6.0 yrs (+16 yrs)	215 (51)	India MkII	9	6	9.3
PE5	**Ngara** – Kihinga (Nyakiganga)	6.0 yrs (+13 yrs)	100 (18)	India MkII	13	4	14.4
PE6	**Ngara** – Kyenda (Gwachungura)	3.1 yrs	200 (48)	Nira	20	2	17.9
PE7	**Kibondo** – Katanga (Bugarama)	1.5 yrs (+3.5 yrs)	715 (152)	Nira	19	2	15.2
PE8	**Kibondo** – Nyaragusu (Nyamilembo)	1.2 yrs	450 (100)	Nira	48	5	17.9
PE9	**Kibondo** – Kibuye (Chona)	1.0 yrs (+8 yrs)	380 (65)	Nira	18	4	13.1
PE10	**Kibondo** – Nyakayenzi (Kwa Kasigara)	2.2 yrs	309 (52)	Nira	20	2	16.1
PE11	**Biharamulo -** Rwekubo (Chalula)	1.1 yrs	226 (24)	Nira	31	6	12.8
PE12	**Biharamulo –** Kabindi (Nyakibingo)	5.5 yrs	826 (200)	Nira	24	2	24.1
PE13	**Biharamulo –** Runazi (Paul)	1.3 yrs (+1.7 yrs)	137(18)	Nira	15	4	18.3
PE14	**Biharamulo –** Kikamakoma (Busota)	5.1 yrs	180 (22)	Nira	24	3	19.2
PE15	**Biharamulo –** Nyakanasi (Kabale)	6.5 yrs	250 (40)	Nira	38	2	14.0
PE16	**Biharamulo –** Nyakanasi (Mtunda)	6.4 yrs	900 (250)	Nira	23	4	6.0
PE17	**Biharamulo –** Nyatankara (Maendeleo)	6.5 yrs	1000 (175)	Nira	22	3	21.4

* age refers to number of years since Concern installed or refurbished the water point. For refurbished water points the additional age since first installation is also given in brackets (e.g. +2 yrs).

† note, Sphere standard recommends max. population per hand pump is 500, based on flow of 17 litres /min

‡ Sphere standard for drinking, cooking and personal hygiene is 15 litres per person per day

Of the 17 WPs, 12 were new installations by Concern, whilst the other 5 were refurbishment of hand pumps installed previously by other NGOs. All of the new hand pumps were Nira AF-85 and 2 of the refurbishments were to India MkII pumps in bored wells. The population served by each water point varied significantly from 120 people up to more than 1000. In this context it should be noted that the national guidelines in Tanzania state that a water point should serve up to maximum of 400 people: 5 out of the 17 hand-pumps were exceeding this usage.

The pump yields between the Nira pumps varied from 15 to 48 litres per minute. Given that all of the hand-dug wells were of the same depth, this variation in yields may have been due to different water table depths, or possibly due to the state of a rubber seal in the Nira hand-pump which ensures discharge on both the upstroke and down-stroke. Three pumps (PEs 15, 16 and 17) were taken apart during the assessment which showed that PE15 had an intact rubber seal, whereas PE 16 and 17 revealed damaged and missing seals respectively. Both these hand pumps exhibited about half the yield of PE15.

The interviews with more than 100 users across all the different WPs included a question on how much water was usually collected per household, with the results shown in Figure 1. The difference between the different average yields at the different WPs can be explained to some extent by whether the users also used the collected water for washing clothes (in addition to using it for cooking personal hygiene, drinking etc.). For example, at several WPs (PE 3, 4, 5 and 11) clothes washing was done either at the WP or in a traditional source nearby; whereas for others (e.g. PE 10, 12 and 17) the water from the pump was carried back to the house where it was used for washing clothes.

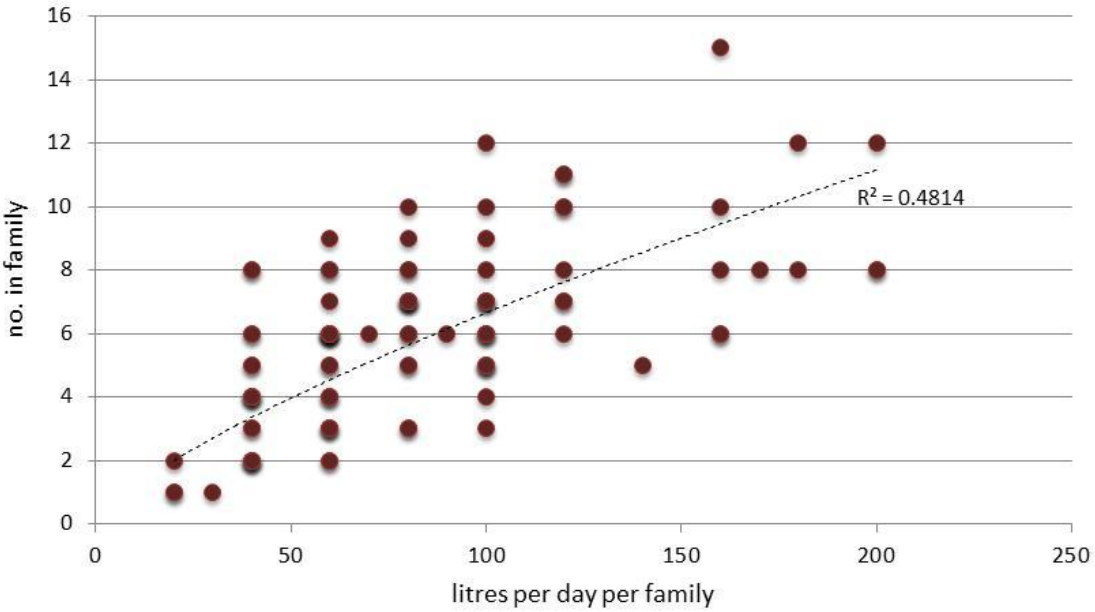


Figure 2. Household water use statistics (n = 101). [Note, mean number of people per family = 5.5]

From the 17 WPs visited, only one (PE2) was not functioning due to a mechanical failure whereby the pump shaft had sheared off (see Figure 3). This had been broken since 2012, although the pump had not really been used much since 2010 as it had been totally dry throughout the dry season. The community and water committee had clearly lost the motivation to repair the hand pump, even though they had repaired it twice in the past, and

were now using a neighbouring water point (which had also installed by Concern around the same time).

Figure 3. Broken hand pump at PE2.

More worrying perhaps was the fact that three other water points (PE 6, 9 and 11), although still functioning, were not being used at all by the local population due to complaints about the water smelling, not tasting good and also running dry during the dry season. In addition, PE14 was not trusted during the rainy season, again due to the smell of the water and only used in times of water shortage during the dry season. In these cases the local population preferred to use nearby traditional unprotected sources. These data are summarised in Figure 4.

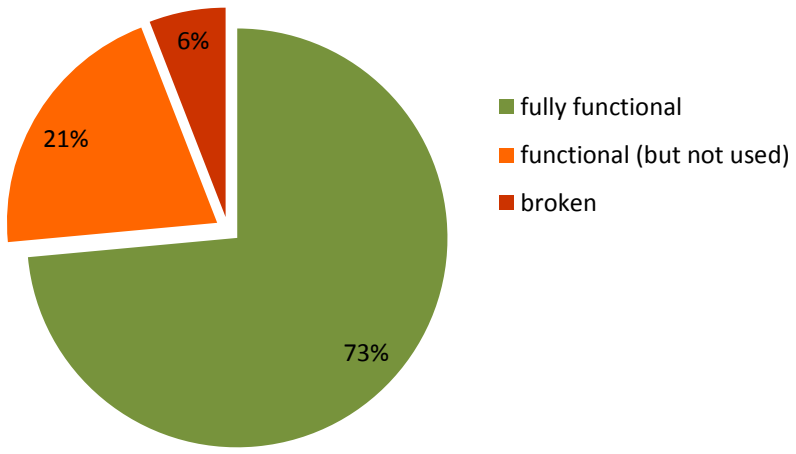


Figure 4. Functionality of water points (n = 17).

A common complaint by several of the WP users and committees (PE 1, 2, 4, 5, 6, 10, 11, 12, 14 and 16) was that the yield reduced significantly during the dry season leading to long queues as people had to wait for the well to recharge; some users reporting that their well

could take up to 30 minutes to recharge between filling each 20 litre container creating queues of up to 4 hours at peak times.

The overall sustainability of the different WPs has been characterised according to three fundamental criteria: the sustainability of the physical infrastructure, the sustainability of the water point committee and the sustainability of the backstopping support.

Table 5 presents a method by which all of the results from the WP physical assessments and questionnaires have been summarised according to 13 different criteria with respect to the sustainability of the infrastructure. These criteria include factors that are related to the initial location of the well, the design of the technology, the quality of installation etc. Whilst the weighting between the different categories could be considered to be fairly subjective, all of these factors can be directly linked to the quality of the water source, the robustness of the technology and the perception of its value by the local users.

Table 5. Water point infrastructure quality sustainability indicators.

Site no.	TST	YLD	DRY	FNC	CLR	SLB	POP	DST	GRD	QUE	BKD	NON	CTM
PE1	10	5	1	3	5	5	4	2	0	3	2	4	5
PE2	2	0	1	0	5	2	3	2	2	3	3	1	4
PE3	10	3	3	3	5	5	2	2	4	4	5	5	4
PE4	7	1	1	0	0	3	3	3	4	1	3	4	4
PE5	10	2	3	0	0	2	5	5	4	4	5	4	3
PE6	0	3	0	0	0	2	4	2	1	4	5	5	3
PE7	10	3	5	4	5	5	0	4	2	3	2	3	3
PE8	10	5	5	5	0	5	1	3	2	3	5	5	3
PE9	5	3	3	4	0	5	2	5	4	1	5	5	2
PE10	7	3	2	3	0	5	2	5	4	3	5	5	3
PE11	0	5	0	3	0	5	3	1	4	4	0	0	3
PE12	10	4	2	2	5	5	0	3	4	1	3	5	2
PE13	10	3	5	3	0	2	4	3	4	5	5	5	4
PE14	3	4	2	0	0	4	4	2	4	3	5	4	3
PE15	10	5	5	0	4	5	3	3	3	4	5	5	3
PE16	10	4	2	0	1	4	0	4	4	1	5	4	2
PE17	10	4	5	0	5	3	0	2	4	4	3	4	3

TST – do the community trust / value the water source [no(0), few (2-5), most (6-9), all (10)]

YLD – pump yield (l/min) [<5 (0), 5-10 (1), 10-15 (2), 15-20 (3), 20-25 (4) >25 (5)]

DRY – yield / recharge reduces in dry season [completely (0) to no difference (5)]

FNC – protection of pump [no fence (0), fence with openings (2-3), fence with gate (5)]

CLR – changes colour after rain [yes (0), no (5)]

SLB – condition of slab & drain [damaged (0) to perfect (5)]

POP – no. of people served by WP [>600 (0), <501 (1), <401 (2), <301 (3), <201 (4), <101 (5)]

DST – max. distance to users (return trip) [>2 hrs (0), 1 hr (2), 45 mins (3), <30 mins (5)]

GRD – gradient / steepness to source [level (5) to >300 m drop (0)]

QUE – length of queues [peak times> 2 hr (0), peak times >1 hour (1), dry season >2 hrs (2), dry season >1 hr (3), peak times < 30 mins, none (5)]

BKD – breakdown frequency (ave. months operation between breakdowns) [<1/5 yrs (5), 1/3 yrs (4), 1/2 yrs (3), 1 per yr (2), 1 per 6 months (1), < 1 per 6 months) (0)]

NON – fraction of time not working since installation [>0.5 (0), <0.35 (1), <0.25 (2), <0.1 (3), <0.05 (4), 0 (5)]

CTM – contamination source nearby, incl. runoff down into well & proximity to open source (river) [houses v. close (0), agriculture (3), none (5)]

Table 6 shows the results from the assessment of the sustainability of each water committee according to 14 different criteria considered important in relation to the management of the committee, how it deals with finances, how it responds to maintenance issues that arise etc.

Table 6. Water point committee sustainability indicators.

Site no.	AGE	MEM	MTG	CSH	REG	BNK	EXT	FND	CVR	SPR	SRC	WRK	TST	HYG
PE1	1	5	3	0	1	0	2	4	2	0	1	10	4	4
PE2	5	3	0	0	2	0	0	4	0	3	3	0	3	1
PE3	2	4	2	3	3	0	0	1	2	0	1	10	4	4
PE4	5	4	4	0	1	0	0	5	5	3	3	10	4	4
PE5	5	0	1	0	2	0	0	3	5	2	3	10	3	4
PE6	3	0	0	0	1	0	0	0	2	0	1	10	0	0
PE7	1	5	3	2	2	1	1	3	5	4	4	10	4	3
PE8	1	5	5	2	3	1	2	1	2	0	1	10	5	5
PE9	1	5	5	3	3	1	0	1	2	0	1	10	5	4
PE10	2	5	3	0	0	0	0	0	2	0	1	10	3	4
PE11	1	5	1	0	0	0	0	3	2	0	0	10	0	1
PE12	4	5	4	5	5	4	4	5	5	4	3	10	5	3
PE13	1	5	4	3	3	1	4	0	2	0	1	10	5	4
PE14	4	3	1	0	0	0	0	4	2	2	1	10	2	2
PE15	5	2	1	0	0	0	1	0	2	0	1	10	4	1
PE16	5	4	1	0	2	1	2	5	4	3	4	10	3	1
PE17	5	4	3	2	0	2	3	5	5	3	3	10	5	1

AGE – age of committee [<1 yr (0), 1-2yrs (1), 2-3 yrs (2), 3-4 yrs (3), 4-6 yrs (4), >6 yrs (5)]

MEM – no. of active members [0 (0), 2(1), 4(2), 5(3), 6-7(4), 8 (5)]

MTG – frequency of meetings [none (0), verbal but no evidence (1-2), once per year (3), once per quarter (4), once per month (5)]

CSH – cash saved [none (0), <5000 (1), <15 000 (2), <30 000 (3), <50 000 (4), >50 000 (5)

REG – regular contributions [none (0), at formation (1), once per 2 yrs (2), annually (3), monthly (4), every day (5)]

BNK – money saved in bank [none (0), none (but receipts) (1-2), loans provided (3), in village communal bank (4), their own bank account (5)]

EXT – plans for extra activities to raise cash [none (0), reactive payment if it breaks down (1), loan scheme proposed (but no contributions) (2), loan scheme (already operating) (4)

FND – local caretaker fixes pump [no (0), just at training (1), minor maintenance (3), full dismantling (5)]

CVR – contributions have covered maintenance in past [no (0), n/a (2), yes (5)]

SPR – knowledge of cost of spare parts [no (0), full knowledge (5)]

SRC – sourced spare parts in past [no (0), n/a (1), from NGO (2), from District Engineer (3), from local supplier (4), from manufacturer (5)]

WRK – is the pump working [no (0), yes (10)]

TST – do the community trust committee [no(0), some (2-3), yes (5)]

HYG – are the committee organising hygiene promotion events (never (0), more than 2 yrs ago (1), more than 1 yr ago (2), at quarterly meetings (3), household visits & at water point more than once per year (4), household visits every month (5)

Finally, Table 7 presents an assessment of the sustainability of the backstopping support available to the water point committees according to 6 different criteria. It should be noted that these criteria do not include access to any ongoing support from Concern or its partners, as these should be not considered as long term backstopping support options.

Table 7. Backstopping sustainability indicators.

Site no.	DST	SSP	HRD	VLG	MCH	FIN
PE1	2	2	1	1	0	0
PE2	0	4	1	2	0	0
PE3	2	2	1	1	3	0
PE4	5	5	1	1	3	0
PE5	2	2	1	2	5	0
PE6	2	2	1	1	0	0
PE7	2	2	2	2	0	1
PE8	2	2	2	2	5	1
PE9	2	2	2	2	0	0
PE10	2	2	2	2	2	0
PE11	0	2	1	1	0	0
PE12	3	4	1	5	4	4
PE13	2	2	1	2	0	2
PE14	2	2	1	2	0	0
PE15	1	2	1	2	0	0
PE16	2	0	1	3	5	1
PE17	1	4	1	4	5	2

DST – response from District Engineer to problems [no response (0), n/a but know who to contact (2), less than 1 week (5)]

SSP – Local Government will supply spare parts to committee [none (0), never asked but know to ask (2), always (5)]

HRD – availability of spare parts in hardware shops [>500 km away (0), > 200 km away (1), maybe in District village (2), in District village (4), in village (5)

VLG – organised water committee at higher level than local water points [none (0), village facilitator actively involved (2), water vendors group (4), village water points organisation (5)]

MCH – other private mechanic available locally [none (0), yes but never used (2), yes and used (5)]

FIN – financial infrastructure available [none (0), private loans (1-2), contribution by Local government (3), access to group bank account (4), own bank account (5)]

The results from the three different sustainability indices (infrastructure, committee and backstopping) have been normalised (i.e. expressed on a scale of 0 to 1.0) for each water point and compared in Table 8. Figure 5 then shows the overall cumulative sustainability scores from these three indicators (out of a maximum of 3.0). It is interesting to note that

these final cumulative sustainability scores do match the same general feeling as to comparative sustainability's between water points from the site visits and water point committee interviews: i.e. PE12, PE17 and PE8 were the best whilst PE2, PE6 and PE11 were clearly failing. Figure 6 presents an alternative comparison between the three different sustainability indices from which their relative size can be more easily compared.

Table 8. Normalized sustainability indices and ranked total scores.

Site no.	Infrastructure	Committee	Backstopping	**Net score**
PE1	0.70	0.49	0.20	**1.39**
PE2	0.40	0.32	0.23	**0.95**
PE3	0.79	0.48	0.30	**1.57**
PE4	0.49	0.64	0.50	**1.63**
PE5	0.67	0.51	0.40	**1.58**
PE6	0.41	0.23	0.20	**0.84**
PE7	0.70	0.64	0.30	**1.64**
PE8	0.74	0.57	0.47	**1.78**
PE9	0.63	0.55	0.27	**1.44**
PE10	0.67	0.40	0.33	**1.40**
PE11	0.40	0.31	0.13	**0.84**
PE12	0.66	0.88	0.70	**2.24**
PE13	0.76	0.57	0.30	**1.63**
PE14	0.54	0.41	0.23	**1.19**
PE15	0.79	0.36	0.20	**1.35**
PE16	0.59	0.60	0.40	**1.59**
PE17	0.67	0.68	0.57	**1.92**

Ranking	Net score
PE12	2.24
PE17	1.92
PE8	1.78
PE7	1.64
PE13	1.63
PE4	1.63
PE16	1.59
PE5	1.58
PE3	1.57
PE9	1.44
PE10	1.40
PE1	1.39
PE15	1.35
PE14	1.19
PE2	0.95
PE11	0.84
PE6	0.84

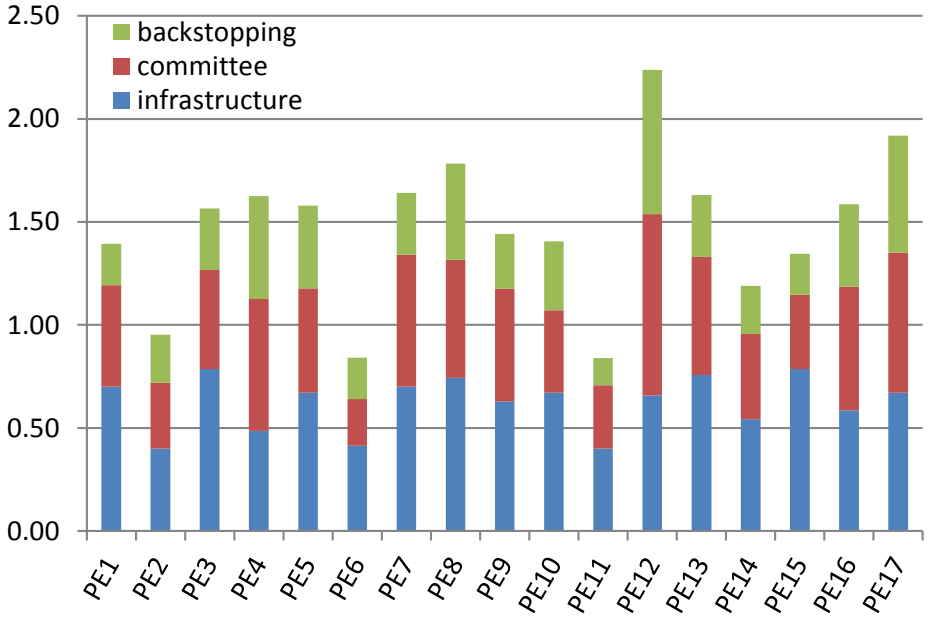


Figure 5. Cumulative sustainability indices for the 17 water points.

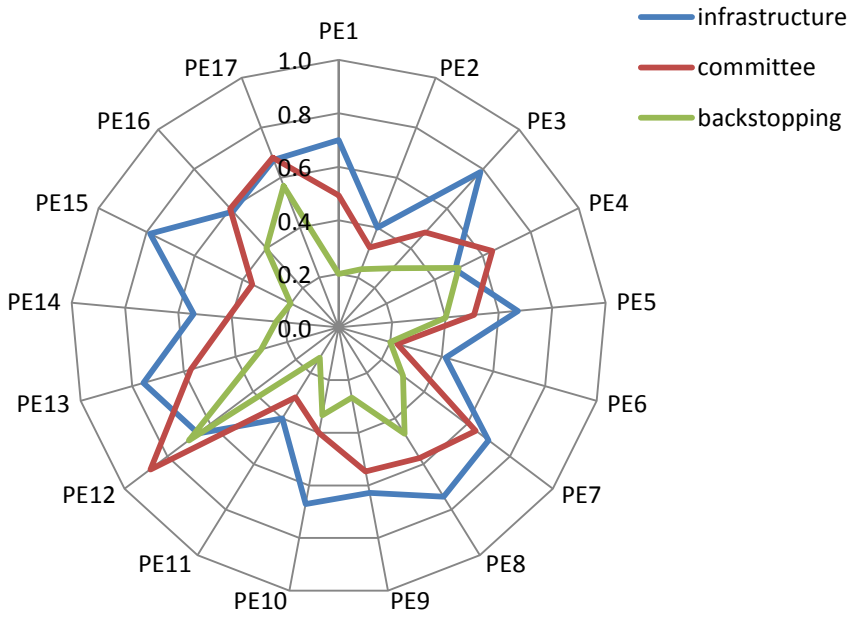
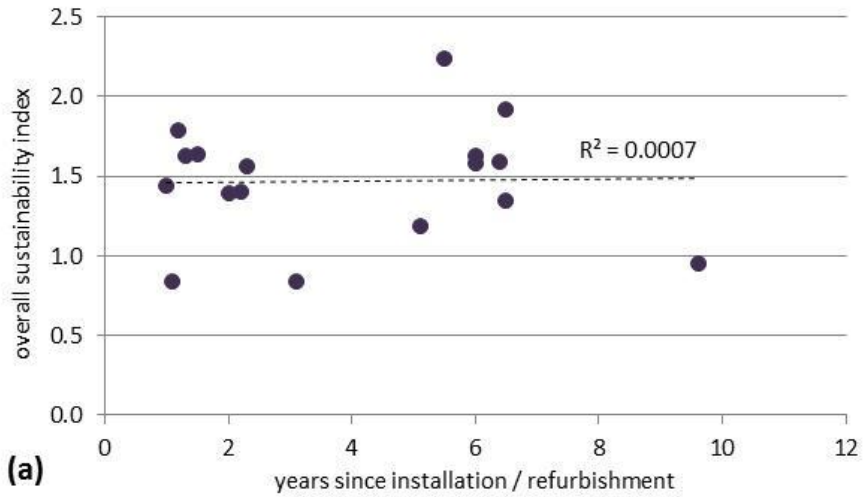
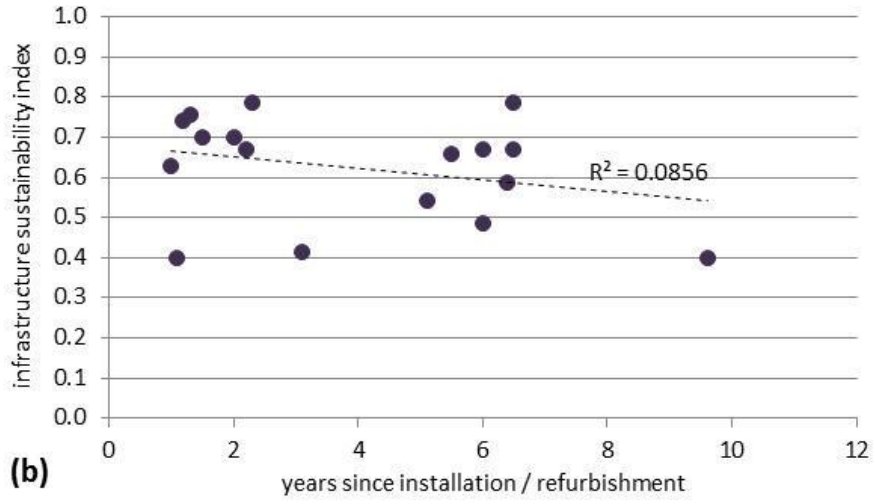


Figure 6. Sustainability indices for the 17 water points according to category.

The results show that there appears to be no significant difference between overall sustainability of water points between the three Districts. Equally, there appears to be no significant difference between the overall sustainability of the water points (out of 3.0) with respect to their age as shown on Figure 7(a). There is a small decrease in sustainability of the infrastructure with age revealed in Figure 7(b) but nothing significant in relation to the sustainability of the water point committees (Figure 7(c)).





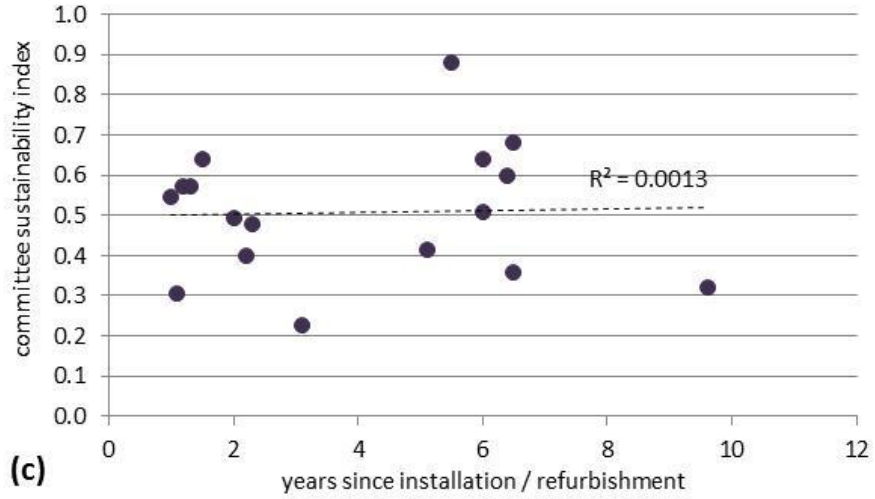


Figure 7. Sustainability indices for the 17 WPs versus their age for, **(a)** overall sustainability (/3.0), **(b)** infrastructure sustainability (/1.0) and **(c)** water point committee sustainability (/1.0).

An interesting finding is that the sustainability of the water points seems to increase with the higher number of users per well, both in terms of overall sustainability (Figure 8(a)) as well as the sustainability of the committee (Figure 8(b)). This is perhaps an indication that the more highly used water points are more valued by the community.

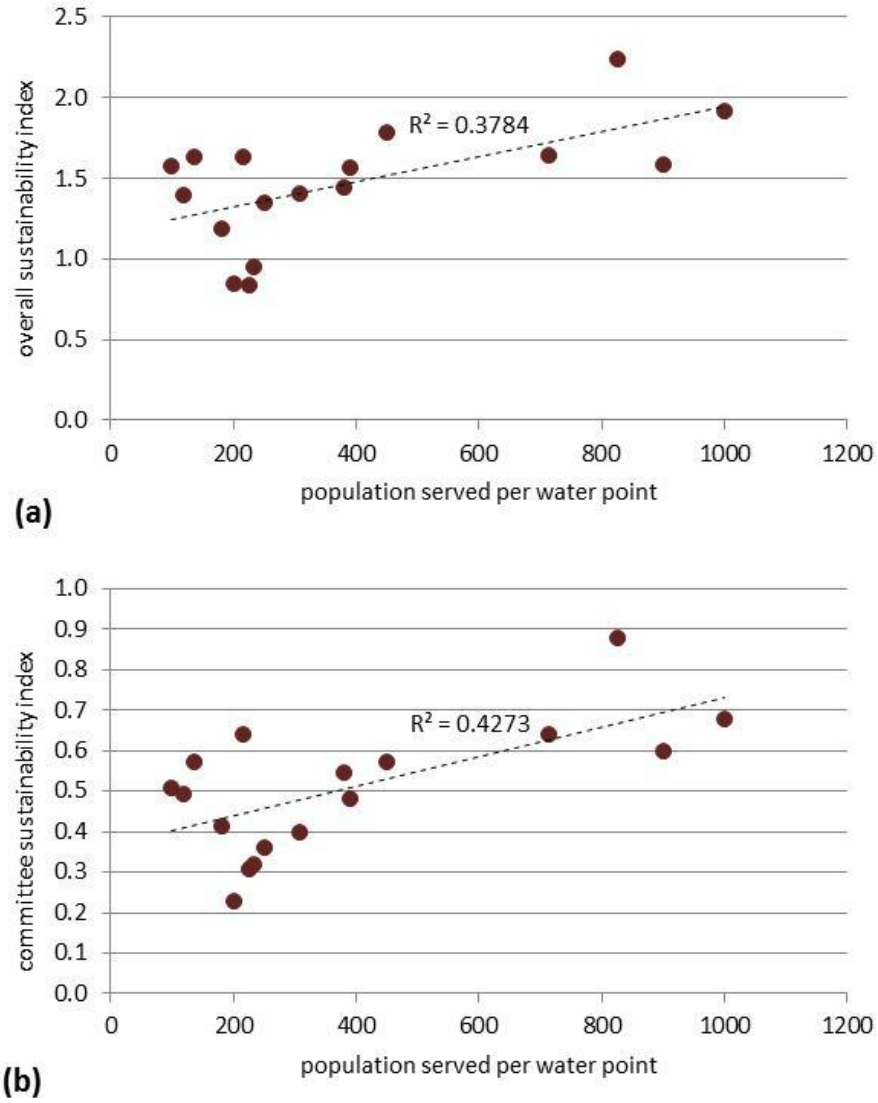


Figure 8. Sustainability indices for the 17 WPs versus their user population, **(a)** overall sustainability, and **(b)** water point committee sustainability.

Assessment of infrastructure of water points

There appears to be an issue for 10 out of the 17 of the wells with the water changing colour after heavy rainfall events which indicates potential rapid pollution pathways. An example of this is shown in Figure 9 which shows the difference in water clarity from water drawn in the morning following a couple of days without rain (the red bucket) compared to water pumped during our visit just after a rainfall event (the white buckets). This is of some concern from both a water quality perspective as well as the local community's perception. As stated earlier, three of the water points were effectively failed points as they were not being used by the community who considered that the water was not good enough to use. In addition, at two of the wells, users reported that worms sometimes were in the pumped water during the rainy season. The siting of some of the wells was very close (<30 m) to surface water (rivers or other traditional wells) which provides a contamination source and potential for very rapid pollutant transport into these shallow wells (see Figure 10).

Figure 9. Change in turbidity of water pumped from a well following a rain event.

Figure 10. Proximity of PE17 hand pump to traditional open water source.

It should be stated that these hand dug wells should provide a safer water source than the more traditional wells, despite the fact that in some areas the local population preferred to take water from the traditional well, as shown for PE14 in Figure 11. Nevertheless this does highlight the question as to whether such shallow hand-dug wells were the best technology for all of these sites. Presumably the original decision to use hand dug shallow wells for most of the hand pumps was made at the original proposal stage, as discussed earlier, before the exact location of any water point had been chosen. It appears that once the programme activities had begun there was a one size fits all approach to design (as long as it passed the pump test) rather than a more bespoke hydrogeological assessment at each water point location. This may well have been due to the restrictions of the agreed

programme with the funding agencies but is an aspect of the sustainability of the water points that needs to be considered.

Figure 11. Collection of water from traditional open water source, less than 30 m away from PE14.

Many of the users also reported that there were significant problems with reduced yields from the wells in the dry season. Using the pumps under these conditions will put extra strain on the pump which will damage / shorten life of pump. It is not clear how the original site assessment and subsequent well design was related to the size of the population targeted at each water point or related to the water table depth. The test auger holes with determination of yield using the jolly jumper methodology were carried out in the dry season (which is good practice), but clearly the assessment was not adequate with respect to determining the sustainable yield and matching that to the expected use, particularly for some of the higher populations. An example of a well sited and installed well is PE15 (Figure 12), which had been operating for 6 years without any maintenance required (despite the fact that the committee had never received any formal training). This water point scored very highly on the infrastructure sustainability index (1st with 0.79) but low on the committee sustainability index (14th with 0.36), as shown in Table 8. Hence, this clearly indicates the importance of appropriate site selection and technology with respect to the sustainability of a water point. In contrast, an example of a poorly sited well is PE11 (Figure 12(b)) that was installed in 4th October 2013, had to be dismantled after a problem on 13th October 2013 and then ran dry in November 2013. It only started producing water again in September 2014 but the local community now complain that the water smells and so won't use it.

Figure 12. A tale of two water points: (a) PE15 – 6 years of operation without maintenance (b) PE11 – dry for most of its 14 months since installation and not used by community.

Several comments were made in the Ngara District about siting hand pumps at the bottom of the valleys when generally most of the population live up high along the ridges, as it is very strenuous to have to carry the water back up the hill. The alternative is to this would be to pump the water up to the villages using either diesel or solar powered pumps. During the visit a solar pumping installation by Concern was visited (see Figure 13) which had been running well for more than 18 months. However, it should be noted that such schemes are more expensive and have more serious maintenance requirements than hand pumps. The cost for the solar pumping scheme was 40 million Tsh which supplied water to around 1000 people: this should be compared against the 3.5 million Tsh cost for each shallow hand dug well.

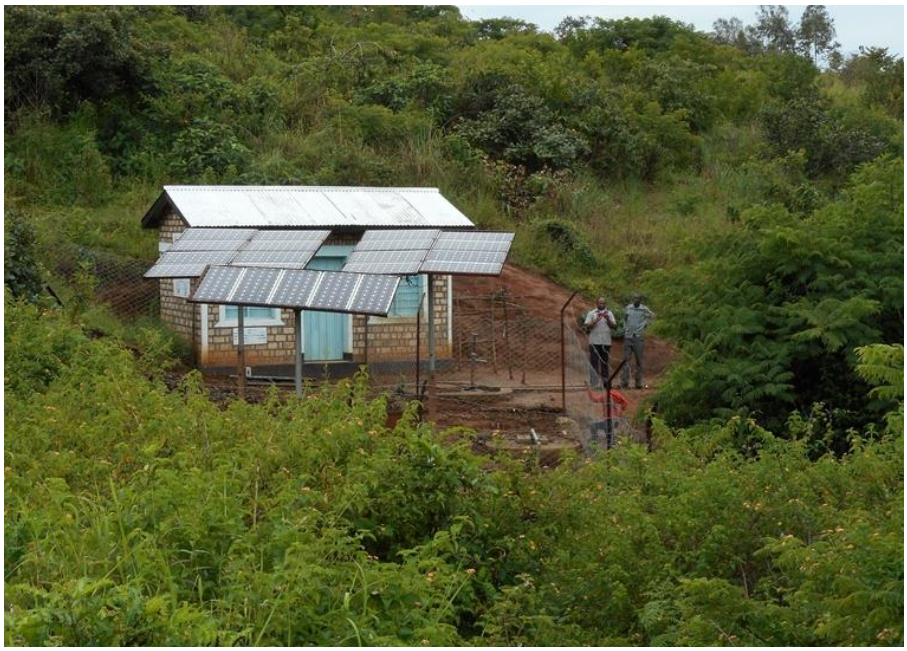


Figure 13. Solar pumping scheme installed in Ngara District by Concern.

Management of water point committees

All the members of the water point committees seemed to have been selected during a general meeting of the sub-village, whereby members were proposed for the different roles and if they agreed, a vote was then taken to confirm their position. In most cases however, if members left the committee (because of moving away from the village or death) very few committees seemed to have acted to organise new elections to replace them, with the notable exceptions of PE 12 and 16. The water point committees all seemed to have the same format with chairperson / secretary / cashier / pump attendant / 2 x hygiene members / 2 x general members. However, even though it was emphasised during the training that half the members should be female, the reality seems to be a little different with 42% females on making up the general committees and with only 27% of four key roles occupied by women.

In general most committees confirmed that they had received training from Concern and their partners around about the time of the installation of the hand pumps, but it seemed that the training had been grouped whereby several committees from one village (where more than one water point was being installed) were trained together. This means that in some cases the pump attendant, for example, was not trained to dismantle his actual pump. Three committees (PE 1, 5 and 15) reported that they had not received any training from Concern or partners, whilst the new committee at PE16 (which had replaced the old dysfunctional committee which had received the original training) had also never been trained.

Table 9. Roles and gender split of water point committees.

Site no.	Chairperson	Secretary	Cashier	Caretaker	Health mem.	Health mem.	Member	Member
PE1	M	F	M	M	F	F	F	M
PE2	M	M	-	-	F	F	F	-
PE3	M	F	M	M	F	F	M	M
PE4	M	F	F	M	F	F	M	-
PE5	M	F	M	M	F	-	F	M
PE6	-	-	-	-	-	-	-	-
PE7	F	M	F	M	F	M	F	M
PE8	M	F	M	M	F	M	F	M
PE9	M	F	M	M	F	F	M	M
PE10	F	F	F	M	F	M	M	M
PE11	M	M	M	M	F	F	M	M
PE12	M	M	F	M	F	F	F	M
PE13	M	M	F	M	F	F	F	M
PE14	F	M	-	M	F	-	-	-
PE15	M	-	-	M	-	-	F	M
PE16	M	M	M	M	-	-	F	F
PE17	M	F	M	M	F	M	M	M

There was evidence of minutes being kept from meetings for up to one year after committee formation by 14 out of the 17 committees (see Figure 14(a)), but the frequency of meetings and minute taking generally started to peter out for the older water points.

Figure 14. Example of (a) water committee minutes and (b) accounts with receipt book (from PE8).

In most cases the water points were never locked and free access was allowed 24 hours per day. The exception to this was PE8 (open from 7am to 7pm), PE12 (open from 7am to 1pm and 4pm to 6pm with a member of the committee was on guard to collect money), PE13 (locked at night), and PE15 (open from 6am – 10am and 12pm to 6pm).

Finances

Most committees had started to collect some money from the users just after the pump installation and committee formation with the typical amounts varying from about 500 to 2000 Tsh per family per year. However, this collection seemed to be stopped after the first collection, particularly if there had been no maintenance problem with the pump. The main use of any collected money was to fix pumps (not for payments to committee) and the users generally trusted that their committees would use the money for the benefit of the water point. Some families were exempt from having to pay for example, widows, elderly people and the poor. No committees reported that they had ever received any additional contribution from Local Government.

There was generally little idea in the committees of what it might cost to maintain a pump – i.e. how much spare parts would cost: with 11 committees out of the 17 saying that they had no idea of any spare parts / maintenance costs with the remaining 6 only knowing one or two indicative costs (such as the price of bolts or price of a foot valve) from their own experience of having to pay for them in the recent past. Therefore, the financing of any required maintenance appeared to be carried out on a very reactive basis. In most cases this seemed to work – after all, only 1 pump out of the 17 visited during the assessment was not functioning – although it should also be borne in mind that many of the pumps had yet to exhibit any maintenance problems due to the robustness of the Nira hand pump technology. The only exception to this reactive financing practice was at PE12 where 20 Tsh per bucket was charged during the dry season. A member of the committee stayed at the pump during opening hours (7am to 1pm and 4pm to 6pm).

It should be noted that 13 out of the 17 committees complained that when funds were sought only a fraction of the community seem to pay: for example in PE7 only 34 out of 152 households using the pump contributed 1000 Tsh the last time the pump had needed to be repaired, although they did raise enough money to sort out the problem. In general there was very little book keeping apart from during the initial year following installation.

In all committees, with the exception of PE12, money not put in bank account, just kept temporarily in a cash box unit it was used to pay the mechanic. It was strongly expressed across all the Districts that the idea of opening a bank account would not be possible for such a small amount of money that would typically be collected on a regular basis by a water point committee. PE12 was the only committee which did keep their funds in a bank account, but this was a joint bank account shared between several water committees in the whole village which consisted of 6 shallow hand-pump water points, 1 deep bored well and one pumped gravity distribution scheme. Although this seemed to be good practice, the committee from PE12 were wary about what their collected funds were being used for by the central village administration.

It is instructive to give some comparative costs so that an annual fee of 1000 to 2000 Tsh per family per year can be put in context. For example, an average family income is 2000 Tsh per day; a chicken can be sold for -7000 Tsh; a cheap mobile phone costs ~ 20 000 Tsh; water vendors sell 20 litre jerry cans of water (e.g. at PE16) for 100 Tsh.

It was established that costs for spare parts for the pumps were as follows:

Foot valve (for Nira pump) – 15 000 Tsh
Piston seal - 5 000 to 8 000 Tsh
Bolts – 4 to 6000 Tsh
Riser rod – 20 000 Tsh

The additional costs maintenance costs that could be expected are:

Typical caretaker charge per visit ~ 5000 to 10 000 Tsh

District Engineer charge per visit – 25 000 to 50 000 Tsh
(plus 20 000 Tsh for transport plus cost of spares)

Finally, some reported costs to fix pumps in the past that committees had to pay either to the local caretaker or a Local Government Technician are as follows:

- 18 000 to repair riser pipe (PE2): 16 000 to repair slab (PE2)
- 15 000 to replace rubber seal (PE4): 30 000 to replace riser pipe (PE4)
- 35 000 to replace rods (PE5)
- 7 000 for minor maintenance (PE7): 13 000 for minor maintenance (PE7)
- 70 000 to replace riser rods (PE9)
- 85 000 for one visit incl. spare parts (PE12)
- 25 000 to unblock riser pipe (PE14)
- 38 000 to replace cylinder and bolts (PE16)
- 25 000 to replace foot valve (PE17): 35 000 to repair apron (PE17)

Hence, this shows that even if it costs 100 000 Tsh per visit to fix the pump this might only equate to 1000 to 2000 Tsh per household per year for a typical water point, which would seem to be fairly within most people's means.

Maintenance

Each water point has a pump caretaker / technician ('*fundi*') with a set of tools who did seem to have been trained and did know how to take a pump apart. In many cases, however, no maintenance had been required since the original training and there was little evidence of any preventative maintenance being carried out at any water point.

Several of the committees which had successfully maintained their water points over the years (PE 4, 5, 7, 12, 16 and 17) were happy to pay their *fundi* for the service at a rate of about 5 000 to 10 000 Tsh per visit (excl. spare parts). Alternatively, some who apparently seemed to have some personal contact with the District Engineer's office had managed to get a Local Government technician to come out at a charge 20 000 to 40 000 Tsh per visit.

The access to a good mechanic, whether the *fundi*, a local private operator or government technician, did seem to be a key element in the long term sustainability of the water points. As discussed previously, when the need had arisen, most water committees had managed to raise the money for maintenance fairly quickly, but they did need have the trust and access with such a mechanic in order to get the problem solved quickly.

Most of the committees did not really know where spare hand pump parts could be sourced from locally, apart from via their District Engineer's office and as discussed previously, there was only a vague idea of the cost of spare parts. However, access to spare parts from the Local Water Department had proved successful in a few cases. It was not clear whether spares could be bought in local hardware shops and so the supply chain was very limited in that aspect. However, having said that, the lack of access to spare parts did not appear to be a major issue given that 16 out of the 17 pumps visited were functioning well. It should be noted that for 8 out of the 17 water points there no maintenance had yet been required since the time of installation / refurbishment and so in a sense those committees were relatively untested.

Finally, an interesting observation was that there were a few motorbikes in the villages as well as wheat milling machines and many bicycles, all of which are much more complicated to fix than the hand pumps. For these an adequate local supply chain had clearly developed with local shops supplying spare parts and capable mechanics. One difference that might explain this is that are there are a lot more bikes / motorbikes etc. than hand pumps in the area, which would stimulate a local supply chain.

Figure 15. Pump caretaker for PE17 dismantling pump showing the Nira AF-85 foot valve.

4.0 Discussion of Results

- *Selection and operation of the water point committees*

The committee members were all elected initially by a public meeting and popular vote, which seemed to suit the communities as a procedure. However, very few committees had replaced members who had left or held second elections to refresh the committee at regular time intervals. It is not clear whether this was considered to be a problem by the community, for example whether they were less trusted as a result, but the committees without the complete set of 8 members (PE 2, 14 and 15) did reveal low scores on the committee sustainability index (see Table 8). Interestingly the committee for the water point that came out top with regards to the overall sustainability index, PE12, reported that the community had been dissatisfied with the original committee who had been deemed to be ineffective and so the whole committee had been replaced in 2012.

The only members on the committee who were being paid were some of the caretakers each time they fixed the pump, which seemed to be an accepted practice by the local community and also seemed to engender a sense of responsibility and respect in many ways for that position. No one else on the committees seemed to expect to be paid and seemed happy that the committee positions should remain voluntary.

- *Training of local water point caretakers*

The initial two day training of the water point caretakers was generally carried out at the time of pump installation which was good practice. However, for many water points that was the last time the caretaker had carried out any maintenance, in part due to the robustness of the Nira hand pumps, and it was not clear whether they would still have the confidence to attempt to dismantle the pumps after such a long period when the pumps inevitably will require maintenance. Ideally a refresher training should be carried out 12 to 18 months later, during which each caretaker would have to dismantle their own pump. This additional time would need to be factored into the original WASH programme proposals. It should be noted that the last two WASH programmes (Water Facility and ongoing Wash Programme), did not allow this time, with only 3 to 6 months maximum post installation support, although a subsequent proposal was made to the Scottish government along these lines but was not funded.

None of the caretakers appeared to carry out any routine preventative maintenance and it was not clear whether this was encouraged as part of the training. The caretakers should be taught to strip the pump for routine maintenance once every 6 months in order to tighten the rods and clean the valves etc. This is a very quick procedure and can be done in about 30 minutes. Such preventative maintenance will help to maintain the caretakers' skills, engender confidence and value in the mechanic by the community, as well as preventing more catastrophic failures. One of these routine maintenances for example, could also be scheduled for the refresher training after 12 or 18 months post-installation from which feedback can be given by the NGO to the mechanic and also lessons learnt by the NGO.

- *Organisation of pump mechanics*

Most of the committees that had managed to successfully fix any problems with the water points were those who either had a good mechanic as the pump caretaker who they paid, or access to a good local mechanic who they paid to fix the pump. Most of the water point

committees did seem to have access to appropriate tools to fix the pumps if needed; for the new installation one set of tools was given to each committee.

The main potential problem regarding maintenance was access to specialised spare parts, as discussed later. Given the clear limitations in the capacity of the Local Government District Water Departments in being able to respond to maintenance requests (and the fact that they charge the water committee anyway for their time), an alternative strategy towards water point maintenance that could be considered for future programmes would be to train and set up a skilled mechanic in private business to cover many water points, for example one pump mechanic per District to cover around 100 to 200 water points. This mechanic could be supplied with a motorbike and then would make routine visits say once per year to every water point to carry out preventative maintenance which each committee would pay for. This would have the advantage that the committee and community would know that there would be a modest regular fund required every year, rather than the current practice of collecting funds reactively when the pump does break down. The mechanic would also be on call for any emergency maintenance required and would obviously become very experienced at knowing how to fix such pumps quickly. It would also be in the mechanic's interest to source and stock a supply of spare parts (from Dar Es Salaam or Mwanza), which would be financially viable for such a business given the number of water points that would be covered. This is in contrast to the current system of one caretaker per pump where it just isn't worth trying to source and stock spare parts for some future breakdown.

- *Nature and effectiveness of the supply chain*

There didn't appear to be any direct commitment from Concern or partners with respect to developing the supply chain for pump spare parts or mechanics as part of any of the WASH programmes. The assumption is that the Local Government Water Department will provide the main link in the supply chain, which could work as a model as long as they are resourced adequately - unfortunately this did not seem to be the case. At the beginning of the WEHP programme the supply chain was analysed in relation to the choice of the Nira hand pump as the main technology for all the new installations which was carefully considered and is to be encouraged in any future programme. However, beyond that, there does seem to be a potential problem with access to spare parts in the Districts which may impact on the sustainability of water points going forward. It should be noted again that for 8 out of the 17 water points no maintenance had yet been required since installation / refurbishment as they were still relatively new and so in a sense both the committees and supply chain are still relatively untested. However, given that most of the pumps were working, it could be argued that the technology was robust enough and easy to fix locally, at least over the 6 year time span assessed. There does seem to be both the economic resources and the motivation in the communities to pay for maintenance of the hand pumps and so the alternative strategy of having a more centralised private mechanic (as discussed above) could be considered in future programmes in order to generate a more local access to spare parts and mechanical expertise.

- *Economic analyses / cost recovery*

The overall impression was that there is enough money in the local communities to react retrospectively to any maintenance required if the community served is large enough and the water point is valued enough, as opposed to the recommended practice during training

whereby the committees should organize regular collections, which really didn't seem to be sustained past the first year for most water points. The maximum cost reported for maintenance to any water point was 85 000 Tsh at PE12. This sum could be raised by most committees by charging households as little as 1000 Tsh – which would appear to be relatively easy to pay in relation to the apparent economy of the area. The main limitation with respect to fixing a broken pump, as discussed above, is the potential time it could take to get access to spare parts and a mechanic, particularly if relying on the Local Water Department.

5.0 Conclusion

The number of hand dug wells installed and committees set up in the region over the past 7 years by Concern's WASH programmes is impressive. The process by which communities were selected, their subsequent sensitisation and involvement with regards to the water point location and construction, and training of water point committees all seemed to be carefully thought out and well executed in general, with the aim to ensure the sustainability of the water points. In addition, it did seem that a lot of effort had gone into the choice of hand pump for the programmes, to ensure that the technology would be robust, easy to maintain and have access to spare parts (being manufactured in Tanzania).

The water point committees do appear to be performing a crucial function in relation to the sustainability of the water points and the members on the committee seemed to be content with the voluntary nature of their roles. There was the feeling during the interviews with the committees that some aspects of Concern's committee model did not sit naturally with them, such as the frequency of meetings expected, the taking of minutes, the regular collection of funds etc., and so these hadn't really been embraced and had started to slip after the first year. However, given that 16 out of the 17 water points were functioning, the modus operandi that had developed did seem to be working for most committees. There was a range of commitment and enthusiasm evident between the different committees and in some cases the most effective committees were dependent on just one or two strong personalities. It should also be recognised that for 8 out of the 17 water points no maintenance had been required to date since the installation / refurbishment of the water point as they were still relatively new and so, in a sense, the committees are relatively untested.

There is a concern with the fact that four of the water points, although still functioning, were not being used by the local population due to complaints about the water smelling, not tasting good and also running dry during the dry season. Indeed, many of the other communities that were using the shallow hand dug wells also reported that the water changed colour after heavy rainfall events (indicating potential rapid pollution pathways) and limited yields during the dry season. Hence, this would suggest that more care needs to be taken with where such shallow hand dug wells are sited and whether such technology is appropriate in all situations. Poor water point design and installation will impact on the overall sustainability of the programme, particularly with regards to how often a pump will need to be maintained and also whether the water point is trusted by the community, both in terms of water quality and quantity (availability) throughout the year. There was a clear correlation between the sustainability indices of the water points and size of population served; the more in demand the water point the more likely it is to be maintained and

valued by the community, in addition to the larger communities having a better financial capacity to fix problems. This observation might provide somewhat of a conundrum in relation to the provision of reasonable access to water for a community and yet building in such an inherent sustainability into a WASH programme. However, from this survey it would seem that a minimum user population of around 100 households would be an appropriate target to aim for per water point.

There is an understandable desire for any WASH programme to aim to provide access to safe water for the biggest population possible for the funds available, but the choice of technology must be appropriate for the conditions where it is being applied. Hence, maybe fewer water points, some of which might cost more to install (such as bored wells), could be more effective and sustainable in the long term than many shallow hand dug wells installed across all scenarios. That being said, it needs to be acknowledged that more complex installations such as drilled boreholes will of course require better maintenance and access to spare parts to ensure their ultimate sustainability. Ideally, each site needs to be assessed on its merits and a balanced programme developed. In the Kagera region Concern have also installed solar and other pumping schemes with network distributions and carried out spring rehabilitations that were not visited and evaluated. One option for the future could be to develop the WASH programmes at the proposal stage with some flexibility in them to allow the best technology to be chosen depending on local site conditions and not be pinned down to an exact number of water points of a specific technology. It would also be recommended to include some activities and associated budget towards analysis and development of the supply chain and maintenance capacity in the Districts. For the WASH programmes in the Kagera region it seemed to be assumed that the Local Government Water Department would perform the critical link in the supply chain between the pump manufacturers and the water committees. However, it was not clear that the Water Department were resourced adequately enough to carry out this role for the number of water points that had been set up. The water point committees however do seem to have the economic capacity in their communities to pay for maintenance and so maybe some additional work to analyse and target appropriate interventions in the supply chain would help to ensure the sustainability of the programmes. For example, the budget for one or two additional water points in a programme could be sacrificed towards identifying, training and setting up an affordable, centralised, private mechanic (say one per District with a motorbike) to carry out routine and reactive maintenance of all hand pumps. The length of the WASH programmes should also include a period of at least 12 months post-installation for all water points in order to provide refresher training and feedback to the committees

Finally, the overall community engagement strategy and participation throughout the process of siting, installation of hand dug wells and setting up of the committees definitely seemed to have engendered a sense of ownership of the infrastructure which was heartening. In response to the first question put to the users, "*Who owns the water point?*", every group of users answered without hesitation something to the effect, "*We do! It's our communal property!*".

Appendix A

Concern Tanzania WASH Programme

Post-evaluation Field visit schedule

22nd November -5th December 2014

Time	Activity				Who	Notes
Saturday 22nd November						
	Arrive in Dar es Salaam					
Sunday 23rd November						
5	Transfer to Airport					
6	Fly to Mwanza					
8	Arrive Mwanza travel by road to Ngara					Arrive Ngara 16.00 approx.
Monday 24th November						
08.00-12.30	Meetings with WASH Team					
13.30-16.30	Visit field site (1 site)					
	S/n	Village Name	WP Name	Technology		
	PE1	Murukukumbo	Mukibande	S/Well		Confirmed - accessible
Tuesday 25th & Wednesday 26th November						
	Field work Ngara (4 sites)					
	PE2	Bukiriro	Kwa Mdogo	S/Well		Confirmed - accessible
	PE3	Bukiriro	Mukiyange	S/Well		Confirmed - accessible
	PE4	Bukiriro	Kisima B	S/Well		Confirmed - accessible
	PE5	Kihinga	Nyakiganga	S/Well		Confirmed - accessible
Thursday 27th November						
AM	Field Site Ngara (1 site)					
	PE6	Kyenda/Nyakiziba	Gwachungura	S/Well		Confirmed - accessible
PM	Travel to Kibondo					
Friday 28th & Saturday 29th November						
	Field visit Kibondo (4 sites)					
	PE7	Katanga	Bugarama	S/Well		Confirmed - accessible
	PE8	Nyarugusu	Nyamilembo	S/Well		Confirmed - accessible
	PE9	Kibuye	Chona	S/Well		Confirmed - accessible
	PE10	Nyakayenzi	Kwa Kasigara	S/Well		Confirmed - accessible
Sunday 30th November						
	Travel to Biharamulo					
Monday 1st –Wednesday 3rd December						
PM	Field work Biharamulo (6 sites)					
	PE11	Rwekubo	Chalula	S/Well		Confirmed - accessible
	PE12	Kabindi	Nyakibingo	S/Well		Confirmed - accessible
	PE13	Runazi	Paul	S/Well		Confirmed - accessible
	PE14	Kikamakoma	Busota	S/Well		Confirmed - accessible
	PE15	Nyakanasi	Kabale	S/Well		To be confirmed; if not there are alternative sites
	PE16	Nyakanasi	Mtunda	S/Well		Confirmed - accessible
Thursday 4th December						
	Field work Biharamulo (1 site)					
	PE17	Nyantakara	Maendeleo	S/Well		Confirmed - accessible
11.00	Travel to Mwanza					
Friday 5th December						
AM	Fly to Dar es Salaam					
	Debrief in DSM					
Evening	Depart for Dublin					

Appendix B

Water point committee questionnaire
[min. 3 members of water committee required per hand pump]

Management & Structure

- How many people are in the Water Use Committee?
- What are the roles and responsibility of each member (incl. gender and age profile)?
- How often are meetings of the Water Use Committee held?
- Are they held on a fixed regular basis or just when an important decision is required?
- Is there an agenda for such meetings in advance and are minutes produced afterwards?
- Can I see some of the minutes as an example?
- Does the Water Use Committee organise regular meetings with the community to discuss management / finances etc?
- Did the water committee receive any management training from Concern?
- How were individuals chosen to be on the water committee? (*election / voluntary*)
- How often do people change on the water committee and why? (*end of term / election etc.*)

Finances

- Are users charged to collect water from the hand pump?
- On what is the charge based? *(cost per container, per family, per visit, per month etc.)*
- What is the water charge? *(i.e. how many TZ shillings)*
- How was this tariff determined? (*e.g. on willingness to pay, or based on analysis of running & maintenance costs for water point).*
- What does the Committee think that the local users are paying for? *(provision of water, service, maintenance etc)*
- How is the money collected? *(by a guard at the well, by monthly visit etc.).*
- How is the revenue (money) saved? *(in a bank account, in someone's house etc.).*
- Are financial accounts kept of the income and expenditure? (*book-keeping*)
- Can I see some of the recent financial accounts?
- How much revenue is collected per year from the users?
- Do you receive other income from, for example, Local government? *(how much & often)*
- What happens if someone cannot / refuses to pay?
- Are some individuals / families exempt from having to pay (and why)?
- Do you organise other activities to bring in additional funds to pay for maintenance etc.?

- What is the expenditure per year (on what is the money spent)?
    - Regular wage for pump attendant/ guard *(TSH – if applicable)*
    - Regular wage for person to collect tariff *(TSH – if applicable)*
    - Regular wage for water committee membership *(TSH – if applicable)*
    - Regular preventative maintenance *(TSH)*
    - Major repairs *(TSH)*
- Does the revenue collected cover the costs for running and maintaining the water point?
- Does the committee have future plans to address any financial gaps that have influenced the long-term sustainability? (*if relevant*)
- Did the water committee receive any financial training from Concern?

Maintenance and Repairs

- Who does the committee contact for <u>minor / routine</u> maintenance? (*caretaker / technician type*)
- Does this person live in the village? *(or in the surroundings – how far away)*
- How soon can the caretaker (technician) respond to a maintenance problem?
- How much do they charge per visit? *(TSH)*
- How much do they charge for spare parts? *(see Table later)*
- Does the committee keep a stock of spare parts?
- Where does the caretaker source spare parts?
- Do they have specialist tools to fix the pump?
- Are these tools shared between other water point committee technicians?
- Is routine maintenance carried out at fixed time interval? *(what & how often)*
- Do they provide regular feedback to the committee on the pump status?
- How long does such minor maintenance take on average? (*hours per visit*)
- Has the caretaker / technician ever taken apart the pump completely?
- Was the caretaker / technician trained in maintenance? If so, by who? How long? Hands-on training or not?
- Who does the committee contact for <u>major</u> maintenance? *(i.e. mechanic to fix pump)*
- Does this person live in the village? *(or in the surroundings – how far away)*
- How soon does it take the mechanic to respond to a maintenance problem?
- How many pumps / villages does the mechanic cover?
- Does the mechanic do other jobs? (*or just fix hand pumps*)
- How much do they charge per visit? *(TSH)*
- How much do they charge for spare parts? *(see Table later)*
- Where do they get the spare parts from? *(supplier)*

- Does / can the water committee buy spare parts directly from the supplier?
- If so, are they cheaper than what the mechanic charges? *(see Table later)*
- How long does it take to get spare parts?
- Are spare parts typically delivered to the village or do they have to be collected at the suppliers?
- Do they have specialist tools to fix the pump?
- What have been the reasons for pump failures in the past?
    - Mechanical headworks (e.g. broken handle)
    - Worn seal
    - Broken / damaged pump rods
    - Vandalism / theft
    - Siltation of well
    - Damaged cover plate
    - Contamination
    - General yield (flow) reduction (*due to insufficient aquifer supply*)
- How much does the mechanic charge in total on average per visit to fix the pump (according to the above categories)?
- How often has the pump needed to be fixed? *(mean time to failure)* [*before the last harvest, rainy season etc.*]
- What is the longest time that the pump has been out of action before it has been fixed in the past?
- What is the shortest time that the pump has been out of action before it has been fixed in the past?
- Do you receive additional support from the Local government in relation to maintenance of the water points? (*technical support, tools, training, finance etc.*)
- Have you received ongoing support from Concern over the years with respect to maintenance of the water points?
    - For spares supply
    - For mechanical assistance to fix the hand pump
    - For technical information

Other

- How many people rely on the water point in total?
- What is the maximum distance travelled by someone to collect water from this point?
- Is the well accessible at all times of day? (or closed if guard not there for example)
- Does the water Committee organise any regular hygiene messaging activities (*how often*)?
- What is the nature of the hygiene promotion activities? *(PHAST methodology, theatres etc.)*

- What is the main challenge faced by the Water Use Committee in maintaining a functioning water point (hand pump & well)?

Table of costs of spare parts & pump *(TSH)* – [type of pump = _____]

Spare parts	Cost from mechanic	Cost from supplier	Cost from caretaker
Piston seal Bearings Crank Connector rods *Pump*			
Cylinder Pump head assembly Base plate Pedestal Riser pipe			

Appendix C

Water point users questionnaire
[min. 6 users required per hand pump]

- Who owns this water point?
- How much water is collected per family (per person) per day? (*jerry cans per day*)
- What is the water used for? *(drinking / washing / cooking and/or livelihood - agriculture, animals etc).*
- How many families use the water point?
- How far does the furthest person travel to collect water at the well?
- How long do you have to queue on average to collect water?
- How often has the well not been available to collect water? *(no. of months of the year)*
- Why was the well not operating? *(insufficient yield, mechanical failure etc)*
- If water point not available, where is water sourced from? *(other safe water point, or unprotected source)*
- Are more traditional water sources used at the same time even if the water point is functioning? Why?
- Is the quality of water good from the well?
- How do you know that the water is of good quality?
- If not, what is the problem with the water? *(too salty, bad taste, turbid etc.)*
- Does the quantity of water available vary by season (between wet and dry season)?
- Does the quality of water vary by season?
- How much does the water cost?
- How is the money collected?
- Does the water cost too much or is it OK to pay the amount to get access to the pump?
- Do you think that the water committee use the money for the benefit of the pump?
- What do you think that the water committee use the money for?
- When did you last pay the water committee?
- Do the water committee are regular hygiene promotion events? (how often?)

Appendix D

Questions to Concern WASH team (Ngara) & local partners

Hand pump programme

- What do you assume the lifespan of a well should be?
- What do you assume the lifespan of a pump should be?
- What is the average cost per shallow well?
- What was the average cost per hand pump to Concern? (*and from where was it purchased*)
- What is the cost of spares? (*piston seals, bearings, crank, connector rods etc*)
- What is the cost of maintenance tools?
- What is Concern's preferred hand pump type? (*and why*)
- How was the contract for installing the well set up?
- What was the local community's input into the provision of the infrastructure?
- Did the local community contribute to any of the costs of the infrastructure (either in money or in kind)?
- Did the Local Government contribute to any of the costs of the infrastructure?
- Does Concern require approval from Local government before carrying out programme?

Water committee

- Did Concern set up the Water Committees during each programme or leave it to the local population?
- How much time was given to setting up / training each Water point committee?
- Was this a single training session or several sessions? (*how many, how long etc*)
- Does Concern have a training manual for this?
- Does Concern provide follow-up visits? (*at a regular interval or on demand*)
- Has this training and approach changed over the years? *(particularly in the 3 different time spans (<2yrs, 2-5 yrs, >5 yrs))*
- Does Concern recommend how often the Committee should be renewed and also by what means? *(election / voluntary etc)*
- Do the local water committees get in contact with Concern once the well has been installed – if so, why?

Maintenance

- Did Concern help to set up / train a maintenance team?

- Was this for a local caretaker / technician per pump or for a more mechanically trained team for an area (several pumps)?
- Why was the approach adopted? (*either caretaker or more wider based team or both*)
- How long was the training? *(no. of session, hours per session)*
- What was the training? *(lecture type / or practical based on real hand pump)*
- Did Concern provide tools to each committee for routine maintenance?
- Did Concern supply a set of tools at a central location to be accessed by several different committees?
- Does Concern factor in any provision for providing replacement tools post project?
- Does Concern train the water committees to save money for wear and tear / loss of tools?
- What does Concern assume that the expected life is of maintenance tools?
- Has the nature of this training changed over the years? *(particularly across the 3 different time spans (<2yrs, 2-5 yrs, >5 yrs))*
- Do Concern staff respond to any ongoing requests for maintenance of hand pumps? (*i.e. carry out maintenance themselves once the hand pump has been installed*)

Supply chain

- Before the infrastructure is installed, does Concern assess the type (and number) of existing hand pumps in the district?
- Does this knowledge influence the choice of hand pump?
- Before the infrastructure is installed, does Concern assess <u>where</u> spare parts are available for the chosen pump type in the district?
- Again, does this knowledge influence the choice of hand pump?
- Before the infrastructure is installed, does Concern assess <u>how much</u> spare parts and maintenance tools are for the chosen pump type in the district?
- Again, does this influence the choice of hand pump?
- Does Concern find out whether there are existing mechanics in the area?
- Does Concern interview these mechanics as to their preferred type of hand pump?
- Does this affect the nature of training provided
- Where the hand pumps made and how are they shipped into the country?
- How are they distributed to the regions?
- Where / who are the provincial suppliers for the different hand pumps installed in the region?
- Where / who are the district suppliers for the different hand pumps installed in each District (Ngara, Kibondo and Biharamulo)?

- Who are the main customers for hand pumps (and spares) from these district suppliers? (*NGOs, water committees, private mechanics*)
- Is Concern aware of whether the supply chain has changed / developed over the years in the three Districts?
- Has a supply chain developed in response to the installation of the new infrastructure in any of the three districts?
- What does Concern consider to be the main bottlenecks in the supply chain of hand pump spares to the village?
  - From manufacturers into Tanzania
  - From to national entry port to regional suppliers
  - From regional suppliers to district suppliers
  - From district suppliers to mechanics / water committees
- How long on average does it take a hand pump / spares to travel to from where they are manufactured to the District supplier?
- Where does Concern buy the hand pumps (and spares) from when carrying out its WASH programme? (*direct from manufacturer, from regional supplier, from district supplier*)
- How does Concern transport the hand pumps from where they are purchased to where they are installed?
- What are the costs of a hand pump at the different stages of the supply chain? (*direct from manufacturer, from regional supplier, from district supplier*)

Backstopping

- What does Concern assume that the role and responsibility of the national/local government (and other external support) will be with regards to the ongoing management of rural water supplies?
- What information does Concern provide back to the Local government once infrastructure has been installed? *(pump location, type etc)*
- What is the role of Concern WASH Tanzania (and partners) with regards to routine assistance (monitoring, technical advice, and administrative functions) and its impact on the sustainability and ongoing management of the rural water supply management?

Other NGO approaches

- Is Concern aware of different approaches by other agencies / NGOs that have been used in Tanzania to the setting up, financing etc of rural water points as carried out?
- List different approaches / procedures that are considered successful
  List different approaches / procedures that are considered unsuccessful

Appendix E

Table E.1 Water point physical indicators, sorted by age since installation / refurbishment.

Site no.	Water Point Name	Age	Population (households)	Pump type	Yield (l/min)	No. strokes to get water	Ave. water use (Lcd)
PE9	**Kibondo** – Kibuye (Chona)	1.0 yrs (+8 yrs)	380 (65)	Nira	18	4	13.1
PE11	**Biharamulo -** Rwekubo (Chalula)	1.1 yrs	226 (24)	Nira	31	6	12.8
PE8	**Kibondo** – Nyaragusu (Nyamilembo)	1.2 yrs	450 (100)	Nira	48	5	17.9
PE13	**Biharamulo –** Runazi (Paul)	1.3 yrs (+1.7 yrs)	137(18)	Nira	15	4	18.3
PE7	**Kibondo** – Katanga (Bugarama)	1.5 yrs (+3.5 yrs)	715 (152)	Nira	19	2	15.2
PE1	**Ngara** – Murukukumba (Mukibande)	2.0 yrs	120 (24)	Nira	28	6	12.4
PE10	**Kibondo** – Nyakayenzi (Kwa Kasigara)	2.2 yrs	309 (52)	Nira	20	2	16.1
PE3	**Ngara** – Bukiriro (Mukiyange)	2.3 yrs	390 (83)	Nira	20	4	11.4
PE6	**Ngara** – Kyenda (Gwachungura)	3.1 yrs	200 (48)	Nira	20	2	17.9
PE14	**Biharamulo –** Kikamakoma (Busota)	5.1 yrs	180 (22)	Nira	24	3	19.2
PE12	**Biharamulo –** Kabindi (Nyakibingo)	5.5 yrs	826 (200)	Nira	24	2	24.1
PE5	**Ngara** – Kihinga (Nyakiganga)	6.0 yrs (+13 yrs)	100 (18)	India MkII	13	4	14.4
PE4	**Ngara** – Bukiriro (Kisima B)	6.0 yrs (+16 yrs)	215 (51)	India MkII	9	6	9.3
PE16	**Biharamulo –** Nyakanasi (Mtunda)	6.4 yrs	900 (250)	Nira	23	4	6.0
PE15	**Biharamulo –** Nyakanasi (Kabale)	6.5 yrs	250 (40)	Nira	38	2	14.0
PE17	**Biharamulo –** Nyatankara (Maendeleo)	6.5 yrs	1000 (175)	Nira	22	3	21.4
PE2	**Ngara** – Bukiriro (Kwa Mdogo)	9.6 yrs	233 (57)	Nira	n/a	n/a	13.2