GS1247 Improved Kitchen Regimes - Dowa Boreholes, Malawi

Monitoring Report

GS 5329, GS 5330, GS 5331, GS 5332, GS 5335,

GS 5336, GS 5337, GS 5338, GS 5437, GS 5438,

GS 5439, GS 5440, GS 5441

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Contents

1. Monitoring Report Information

Monitoring Period	MP 1 GS5329: 19/12/2015-31/12/2017 GS5330: 11/01/2016-31/12/2017 GS5331: 20/01/2016-31/12/2017 GS5332: 08/02/2016-31/12/2017 GS5335: 21/02/2016-31/12/2017 GS5336: 26/04/2016-31/12/2017 GS5337: 19/04/2016-31/12/2017 GS5338: 18/05/2016-31/12/2017 GS5437: 16/06/2016-31/12/2017 GS5438: 01/07/2016-31/12/2017 GS5439: 03/09/2016-31/12/2017 GS5440: 23/09/2016-31/12/2017 GS5441: 03/10/2016-31/12/2017
Reference number of the project activity	GS 5329, GS 5330, GS 5331, GS 5332, GS 5335, GS 5336, GS 5337, GS 5338, GS 5437, GS 5438, GS 5439, GS 5440, GS 5441
Version number of the monitoring report	2.0
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2. Project Summary

In Malawi, approximately half the population is without access to clean water and therefore relies on unprotected water sources such as hand dug open wells and rivers for drinking water, which are often contaminated by bacteria and pollutants. One of the key factors influencing water scarcity is the absence of borehole maintenance programs and the high costs of implementation. According to the Rural Water Supply Network over 40% of Malawi's boreholes are non-functioning, thus there is a clear need for improved intervention.

As part of our GS1247 Improved Kitchen Regimes Multi-Country PoA, CO2balance UK Ltd and United Purpose (formerly known as Concern Universal) have developed pure water supply projects in the Republic of Malawi. This project has been registered under the Gold Standard Foundation Programme of Activities (thereafter GS PoA) using the methodology "Technologies and Practices to Displace Decentralized Thermal Energy Consumption. v1.0" (TPDDTEC).

In this project co2balance and United Purpose have provided safe drinking water to communities and reduced the need to boil water as a means of purification through the repair of damaged boreholes and the drilling of additional new boreholes. By providing safe water, the project ensures that households consume less firewood during the process of water purification and as a result there has been a reduction of greenhouse gas emissions from the combustion process. The carbon credits earned through the reduction of emissions have been used, in part, to fund and create a self-sustaining maintenance program.

In total 114 boreholes were drilled or rehabilitated across VPAs in Dowa between the 19th December 2015 and 22nd December 2016. The date, location and number of people served by each borehole in each VPA in Dowa are given in the table below, which forms the project database:

GS ID	Borehole	TA	Start of MP1	Pump Model	Latitude	Longitude	Number of borehole users
GS5329	Chiudani	Chakhaza	19/12/2015	Afridev	-13.53436506	33.47389339	334
GS5329	Chilawo	Chakhaza	02/01/2016	Afridev	-13.47774466	33.64405027	520
GS5329	Mtumbati	Kayembe	02/01/2016	Afridev	-13.55175535	33.47737514	274
GS5329	Chapatuka	Kayembe	04/01/2016	Afridev	-13.54063022	33.52423594	569
GS5329	Bvunguti	Kayembe	07/01/2016	Afridev	-13.65908756	33.69090812	544
GS5329	Tobiasi	Kayembe	09/01/2016	Afridev	-13.80404643	33.49440776	300
GS5329	Sicho	Kayembe	10/01/2016	Afridev	-13.68858959	33.66816291	509
GS5329	Manondo	Chakhaza	13/01/2016	Afridev	-13.24423545	33.62990886	234
GS5329	Simenti	Chakhaza	19/01/2016	Afridev	-13.37675361	33.69272725	156
GS5330	Katupa	Kayembe	11/01/2016	Afridev	-13.69422948	33.62034188	280
GS5330	Malayina	Chakhaza	13/01/2016	Afridev	-13.25098346	33.69173287	574
GS5330	Chima	Dzoole	17/01/2016	Afridev	-13.56222911	33.63796473	506
GS5330	Lemani	Dzoole	18/01/2016	Afridev	-13.55151682	33.6406163	429
GS5330	Bango	Dzoole	21/01/2016	Afridev	-13.49287362	33.73852817	221
GS5330	Chipeni	Dzoole	21/01/2016	Afridev	-13.46015269	33.78011957	493
GS5330	Malanda	Chakhaza	21/01/2016	Afridev	-13.55097753	33.51395372	619
GS5330	Million	Chakhaza	26/01/2016	Afridev	-13.48835647	33.61657278	334
GS5331	Salamba	Chakhaza	20/01/2016	Afridev	-12.90200002	33.53579665	234
GS5331	Kaning'a	Chakhaza	21/01/2016	Afridev	-13.29699407	33.63782753	421
GS5331	Chizinga	Dzoole	23/01/2016	Afridev	-11.02287405	33.58963425	233
GS5331	Moses/Chibisa	Chakhaza	23/01/2016	Afridev	-13.41787998	33.5760738	409
GS5331	Chalemera	Chakhaza	25/01/2016	Afridev	-13.47994604	33.68018103	325
GS5331	Msampha	Chakhaza	28/01/2016	Afridev	-13.48757519	33.58018566	421
GS5331	Mpozela	Chakhaza	29/01/2016	Afridev	-13.53175813	33.6089402	270
GS5331	Master	Chakhaza	03/02/2016	Afridev	-13.28932927	33.57598134	179
GS5331	Chilawo Kanjinga	Chakhaza	09/02/2016	Afridev	-13.48513513	33.64277656	592
GS5331	Msiyakulima	Kayembe	19/02/2016	Afridev	-13.45013503	33.59836834	363
GS5332	Chitwala	Chakhaza	08/02/2016	Afridev	-13.49124688	33.6465072	509
GS5332	Chawantha	Chakhaza	10/02/2016	Afridev	-13.50566304	33.60152801	294
GS5332	Chipuni	Chakhaza	17/02/2016	Afridev	-13.5152517	33.584457	331
GS5332	Dziko	Chakhaza	20/02/2016	Afridev	-13.38381737	33.67862654	345
GS5332	Mtende	Chakhaza	22/02/2016	Afridev	-13.65614026	33.72255728	658
GS5332	Katukumuka	Chakhaza	24/02/2016	Afridev	-13.39381531	33.62340589	673
GS5332	Mbende	Chakhaza	27/02/2016	Afridev	-13.23761334	33.69730685	484
GS5332	Sambani	Chakhaza	10/03/2016	Afridev	-13.34247987	33.47985131	203
GS5335	Kaulimbo	Chakhaza	21/02/2016	Afridev	-13.37593942	33.7314197	179
GS5335	Nalandwa	Chakhaza	21/02/2016	Afridev	-13.35503325	33.6347476	507
GS5335	Chipindi	Chakhaza	02/03/2016	Afridev	-13.5152517	33.584457	260
GS5335	Buza	Chakhaza	23/03/2016	Afridev	-13.65614026	33.72255728	299
GS5335	Mtengeza	Dzoole	24/03/2016	Afridev	-13.34616663	33.52226214	261
GS5335	Mphambanya	Kayembe	01/04/2016	Afridev	-13.68031614	33.61595012	359
GS5335	Malabada	Kayembe	15/04/2016	Afridev	-13.70284436	33.61020112	651
GS5335	Chikalera	Dzoole	17/04/2016	Afridev	-13.65105137	33.62541576	264
GS5335	Msangwa	Dzoole	18/04/2016	Afridev	-13.68877353	33.61460352	297
GS5335	Malangwasila	Kayembe	24/04/2016	Afridev	-13.69307571	33.6296695	395

GS5336	Lunda	Dzoole	26/04/2016	Afridev	-13.67233542	33.74340183	337
GS5336	Mkombe	Dzoole	26/04/2016	Afridev	-13.66176186	33.6916371	487
GS5336	Kaponda	Dzoole	26/04/2016	Afridev	-13.66810138	33.71976436	192
GS5336	Chikhambi	Kayembe	27/04/2016	Afridev	-13.45577355	33.73610481	378
GS5336	Mkhwinda	Kayembe	27/04/2016	Afridev	-13.66779664	33.63962541	875
GS5336	Mkotamo	Kayembe	27/04/2016	Afridev	-13.69147512	33.61536882	415
GS5336	Mkwachale	Kayembe	27/04/2016	Afridev	-13.53804831	33.49102535	315
GS5336	Nyankhwaya	Kayembe	27/04/2016	Afridev	-13.53529028	33.51803249	474
GS5337	Tsilizani	Dzoole	19/04/2016	Afridev	-13.62773945	33.7383163	302
GS5337	Mpotela	Chakhaza	20/04/2016	Afridev	-13.53177626	33.60892177	297
GS5337	Chakuwawa	Dzoole	26/04/2016	Afridev	-13.68192081	33.71216846	428
GS5337	Psyontha	Kayembe	27/04/2016	Afridev	-14.39903763	33.64185106	524
GS5337	Chinyelenyele	Kayembe	30/04/2016	Afridev	-13.69116861	33.04638713	266
GS5337	Katema	Chakhaza	03/05/2016	Afridev	-13.35901786	33.50322936	191
GS5337	Josamu	Dzoole	11/05/2016	Afridev	-13.65614026	33.72255728	307
GS5337	Chimpeni	Kayembe	13/05/2016	Afridev	-13.52622181	33.53912875	331
GS5337	Chibwana	Chakhaza	18/05/2016	Afridev	-13.44030602	33.57525895	389
GS5337	Chiponda	Dzoole	24/05/2016	Afridev	-13.60009375	33.60263445	409
GS5338	Jerenje	Dzoole	18/05/2016	Afridev	-13.4557555	33.73609551	253
GS5338	Mbwelera	Kayembe	21/05/2016	Afridev	-13.69790034	33.54758161	138
GS5338	Kankhumbwa	Dzoole	25/05/2016	Afridev	-13.5396034	33.64969645	397
GS5338	Mgoli	Dzoole	25/05/2016	Afridev	-13.58332428	33.69847079	355
GS5338	Sintala	Dzoole	27/05/2016	Afridev	-13.54704214	33.69766239	351
GS5338	Mbewa Kachere	Dzoole	30/05/2016	Afridev	-13.56100179	33.58530806	198
GS5338	Guma	Kayembe	02/06/2016	Afridev	-13.69746062	33.52091017	244
GS5338	Mbuwa	Kayembe	02/06/2016	Afridev	-13.6887824	33.61465903	443
GS5338	Bvulabango	Chakhaza	03/06/2016	Afridev	-13.36317412	33.49564691	156
GS5338	Nyirazafa	Dzoole	11/06/2016	Afridev	-13.5813033	33.70335439	186
GS5338	Nkhosano Chifupa	Dzoole	17/06/2016	Afridev	-13.06566118	33.42721542	329
GS5338	Jotani	Dzoole	29/06/2016	Afridev	-13.51171978	33.78503632	427
GS5437	Mkwapukwa	Dzoole	16/06/2016	Afridev	-13.45483249	33.74250386	320
GS5437	Chinsewu	Dzoole	25/06/2016	Afridev	-13.43840041	33.79109697	775
GS5437	Kamphinda	Dzoole	25/06/2016	Afridev	-13.48812094	33.76758024	255
GS5437	Kangulu	Dzoole	27/06/2016	Afridev	-13.50084799	33.7746246	533
GS5437	Chimfuti	Dzoole	01/07/2016	Afridev	-13.51171978	33.78503632	691
GS5437	Sumayili	Dzoole	03/07/2016	Afridev	-13.62739792	33.70009767	440
GS5437	Pemba	Chakhaza	18/07/2016	Afridev	-13.66046525	33.51896108	466
GS5438	Mbingwa	Kayembe	01/07/2016	Afridev	-13.54758117	33.5166728	273
GS5438	Chilemba	Dzoole	02/07/2016	Afridev	-13.62388981	33.7000781	122
GS5438	Mashatira	Chakhaza	09/07/2016	Afridev	-14.35446446	33.51180407	627
GS5438	Inje 1	Chakhaza	20/07/2016	Afridev	-13.34247983	33.47986978	251
GS5438	Mmelo	Dzoole	22/07/2016	Afridev	-14.45841293	33.71045692	124
GS5438	Manthepa	Dzoole	28/07/2016	Afridev	-14.25109002	33.65719833	218
GS5438	Tumbi	Kayembe	01/08/2016	Afridev	-13.66585888	33.64768298	1179
GS5438	Chikavumbwa	Chakhaza	04/08/2016	Afridev	-13.26571671	33.60104338	479
GS5438	Chikamphula / Nthunthumule	Chakhaza	18/09/2016	Afridev	-13.32866116	33.60372842	147
GS5439	Makombwa 2	Chakhaza	03/09/2016	Afridev	-13.37794274	33.48014306	705
GS5439	Mndinde	Chakhaza	12/09/2016	Afridev	-13.35864599	33.59160404	242

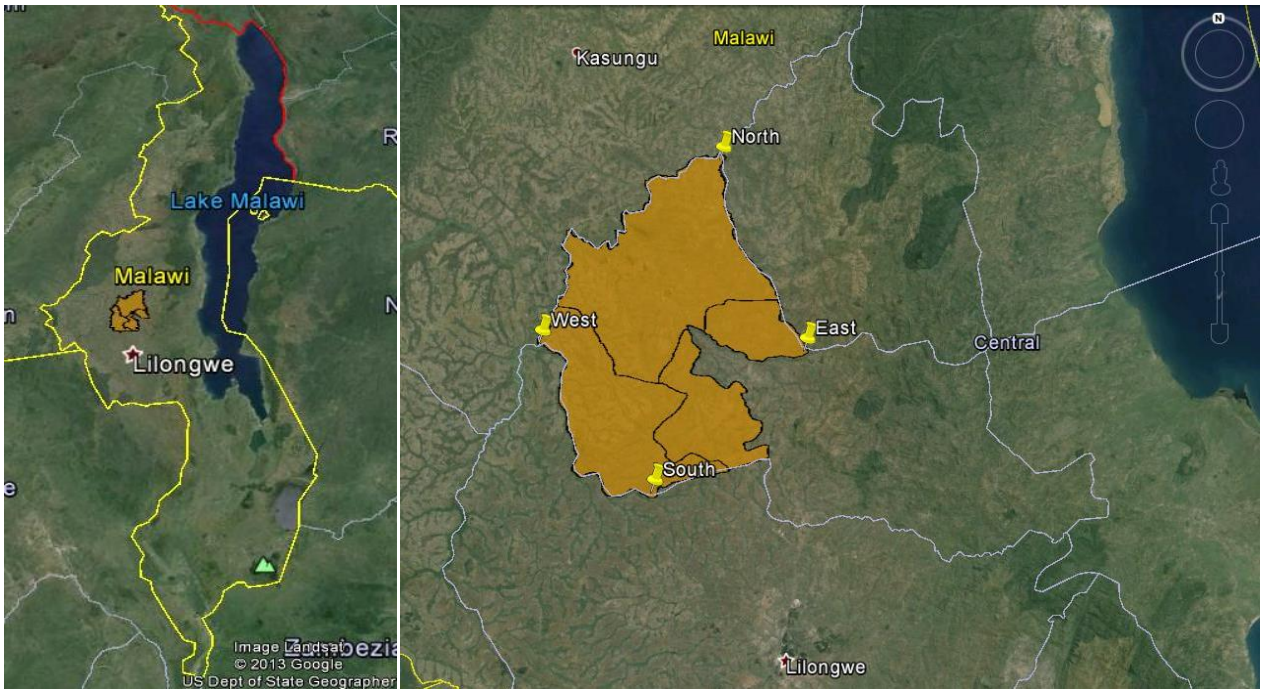
GS5439	Kamkwiyo	Kayembe	14/09/2016	Afridev	-13.5423802	33.74043649	250
GS5439	Kadzimete	Chakhaza	16/09/2016	Afridev	-13.41998499	33.76093459	277
GS5439	Chikadza	Kayembe	17/09/2016	Afridev	-13.74355671	34.02551359	678
GS5439	Shadreck	Chakhaza	21/09/2016	Afridev	-13.39206169	33.64126338	319
GS5439	Kalimbira	Chakhaza	22/09/2016	Afridev	-13.46455997	33.61951434	509
GS5439	Gumulira	Chakhaza	27/09/2016	Afridev	-13.39952267	33.53591734	224
GS5439	Malumbila	Dzoole	28/09/2016	Afridev	-13.34954966	33.57193142	226
GS5440	Milimbu	Chakhaza	23/09/2016	Afridev	-13.70979755	33.62465533	386
GS5440	Nakutepa	Chakhaza	23/09/2016	Afridev	-13.5861	33.87035	519
GS5440	Kanzingeni	Chakhaza	23/09/2016	Afridev	-13.44276748	33.59385126	414
GS5440	Kapudzula/Kapale	Chakhaza	24/09/2016	Afridev	-13.34237492	33.56175715	414
GS5440	Faifi / Five	Dzoole	26/09/2016	Afridev	-13.497856	33.7684891	120
GS5440	Tembwe	Kayembe	01/10/2016	Afridev	-13.69958617	33.56587761	659
GS5440	Sapeya Gude	Chakhaza	05/10/2016	Afridev	-13.4024772	33.51527144	230
GS5440	Chisanja	Dzoole	03/11/2016	Afridev	-13.60484316	33.6587851	734
GS5441	Julayi	Chakhaza	03/10/2016	Afridev	-13.38558123	33.52226385	364
GS5441	Mbetayasamba	Chakhaza	03/10/2016	Afridev	-13.39400926	33.53056673	216
GS5441	Msuzumile	Chakhaza	01/11/2016	Afridev	-13.29263145	33.55481991	717
GS5441	Nkhandwe	Chakhaza	01/11/2016	Afridev	-13.29101637	33.56557158	387
GS5441	Kadzimete	Dzoole	07/11/2016	Afridev	-13.46139749	33.69806024	747
GS5441	Mayani	Chakhaza	17/12/2016	Afridev	-13.01761633	33.60162948	667
GS5441	Khwanya / Nkhwanya	Chakhaza	22/12/2016	Afridev	-13.55680699	33.5195948	317

The date of rehabilitation was confirmed by a Repair Confirmation Form which was signed by the mechanic carrying out the repair along with an elected representative of the community group owners of the borehole. The date of rehabilitation was used as the start date of operation and crediting for each borehole; we have conservatively assumed that the first day of crediting is not counted.

The number of days each borehole credited for in this monitoring period was multiplied by the number of people using the borehole to give the total number of project technology days for that borehole. The individual project technology days for each borehole were totalled to give the total number of project technology days for this monitoring period.

3. Project Location

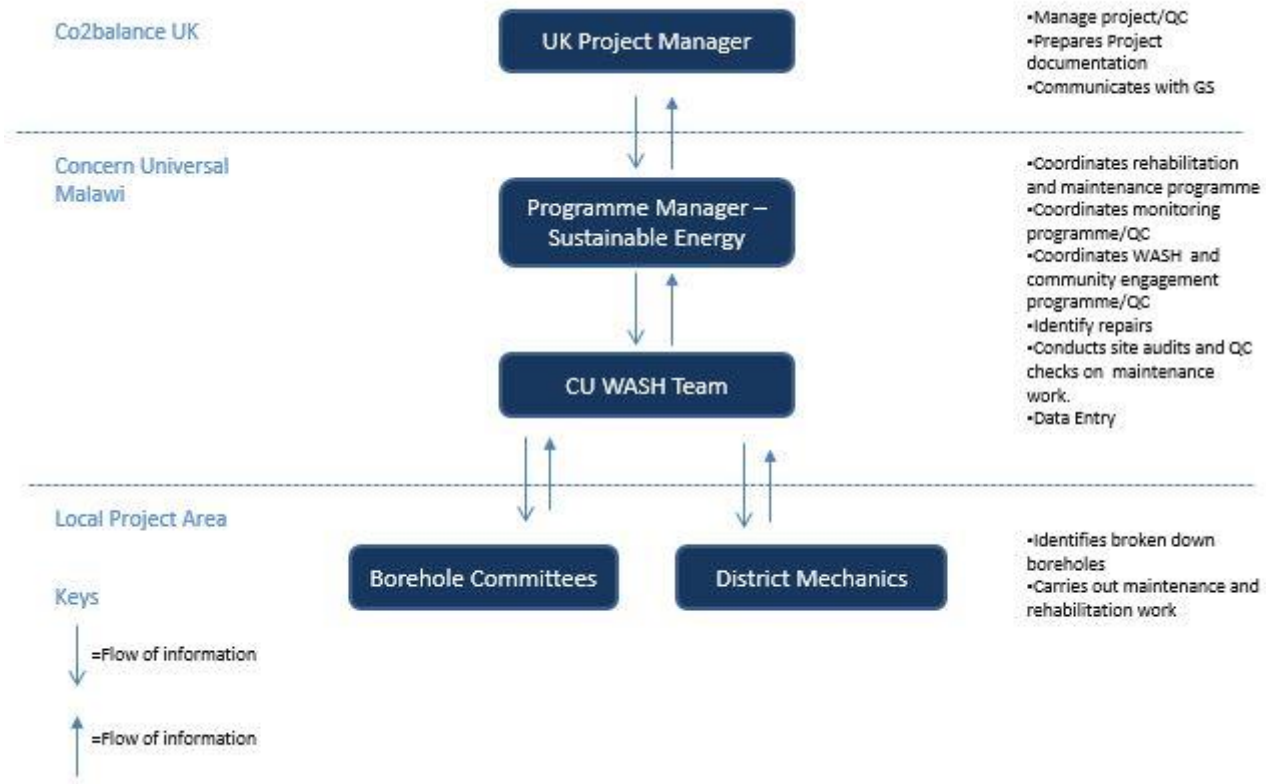
The location of the project activity is within the administrative boundary of Dowa District in the central region of Malawi. Below is the geographic reference to allow unique identification of the VPA Improved Kitchen Regimes, Dowa.



Project Area Extremities		
	Latitude	Longitude
North	-13.206318°	33.702993°
South	-13.716648°	33.578534°
East	-13.505547°	33.825191°
West	-13.480841°	33.409259°

4. Organisational Structure

In this project CO2balance UK ltd is the managing entity and is responsible for communication with the Gold Standard. United Purpose Malawi works with local project field staff who handle all monitoring data collection and processing.



CO2balance and United Purpose work together with local district mechanics that are responsible for the rehabilitation and maintenance of the boreholes, as well as the collection of the data to support this process. The WASH team are responsible for conducting the sensitization meeting, monitoring exercises and identifying any maintenance works. All data that is collected in the field is processed at the local office and sent to the United Purpose Programme Manager for a quality control check prior to sending the documents to the CO2balance UK projects team.

5. Description of monitoring system

All surveys are administered by trained CO2balance staff and partner United Purpose that are local to the area and conversant in the local dialects to ensure that the responses are consistent and not biased by any regional language barriers. Each participant is provided with a briefing on the purpose of the survey and is assured that no individual names are used in the analysis.

The results of the surveys are collated in excel spreadsheets and stored on a central server in an electronic format which is sent to the UK head office for data analysis. The documentation procedure that co2balance has devised ensures a minimum chance of original data being lost – all original copies of our project documentation are retained in the United Purpose Malawi office and are available scanned upon request of the UK team.

In accordance with the Gold Standard methodology Technologies and Practices to Displace Decentralized Thermal Energy Consumption, the survey samples are randomly selected from the borehole user record. Using an online research randomizer, each borehole user, selected from the total user list for all VPAs, is assigned a unique random number which is then sorted in order from lowest to highest. The first *n* number of HHs are selected for the survey. The size of the random sample is dependent on the methodological requirements and variance of the parameter being monitored to ensure the parameters measured satisfy 90/10 precision (90% confidence interval and 10% margin of error). The random sample is reselected for every monitoring period to ensure the selection remains random.

Below is a summary of the key information that has been collected and monitored as part of this project;

5.1 Borehole database

The borehole installation/rehabilitation record includes the following information:

- Date of installation/rehabilitation
- GPS location of the borehole
- Model of the borehole
- Quantity of boreholes installed
- The total number of people obtaining their water from each borehole
- Mode of use: commercial/domestic

The total number of households using each borehole has been determined through the lists supplied by the community group and or district water officer responsible for that borehole. Using this method, the total number of people using each borehole has been determined and hence a figure for person days can be calculated.

5.2 Ongoing Monitoring Studies

The following ongoing monitoring studies were conducted; the results are given in the parameter boxes tables in Section 6.

- **Water Consumption Field Test** (Equation parameters Qp,y and Qp,rawboil,y) – Completed prior to first verification and then biennially. It was conducted on 79 households.

- **Quality of the treated water** - The quality of the treated water is assessed to ensure that it is fit for human consumption. The parameters used to assess the water quality are in line with Malawian standards for potable water and all parameters are shown to be within levels considered acceptable for domestic human consumption.

- **Usage Survey** - As all boreholes were installed within 1 year of the start of the crediting period and are expected to last the lifetime of the project, minimum samples of 30 for different aged technologies are not necessary. Therefore, the annual usage survey was conducted using a minimum sample size of 100.

- **Project Survey** – Conducted on 108 households, surveying end users currently using project technologies to explore changes in project scenario over time.

- **Leakage -** The PDD has described which sources of leakage detailed within the methodology are relevant to this project and which have been discounted. A leakage assessment is provided below.

Individual participants were selected from the borehole user data base using the random sampling process outlined above and in the monitoring plan. Sample sizes are in line with the Gold Standard requirements.

5.3 Cross Sampling

The project proponent has elected to cross-sample technologies across all its homogenous borehole VPAs located within the districts of Dowa and Kasungu. In this monitoring period, cross-sampling was conducted across VPAs 91-104 and 112-116. The sample number of boreholes randomly monitored from the borehole list is in accordance with a 90/30 confidence/precision. The number of households randomly sampled from the user lists of the selected boreholes, is in accordance with the minimum sample size requirements in the Gold Standard methodology for each individual survey and test. Water Quality tests are conducted for each verification as supporting documentation to confirm that each borehole is functioning. Cross sampling is applied to the following surveys;

- Project surveys – Completed annually
- Usage Surveys – Completed annually
- Water Consumption Field Tests – Completed annually

The surveys have been conducted to ensure that they are within the end date of the respective monitoring periods for each VPA and they satisfy the sampling requirements in the methodology. As required for the WCFT, sampling complies with 90/10 precision (90% confidence interval and 10% margin of error), and the sample group is reselected for every monitoring period using an online research randomizer to ensure random selection.

6. Fixed Parameters

The following data was fixed at validation.

Data / Parameter:	$EF_{b,co2}$
Data unit:	tco_2/TJ
Description:	co_2 emission factor arising from use of wood fuel in baseline scenario
Source of data used:	TTPDTEC/IPCC default value:
Value applied:	112
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology: "112 tCO2/TJ for Wood/Wood Waste, or the IPCC default value of other relevant fuel" (p.15)
Any comment:	-

Data / Parameter:	$EF_{b,non\ co2}$
Data unit:	tco_2/TJ
Description:	Non-co_2 emission factor arising from use of fuels in baseline scenario
Source of data used:	IPCC default value: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 Global Warming Potential: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14
Value applied:	8.692
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology

Any comment:	-

Data / Parameter:	$EF_{p,co2}$
Data unit:	tco_2/TJ
Description:	co_2 emission factor arising from use of fuels in project scenario
Source of data used:	TTPDTEC/IPCC default value
Value applied:	112
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology: "112 tCO2/TJ for Wood/Wood Waste, or the IPCC default value of other relevant fuel" (p.15)
Any comment:	-

Data / Parameter:	$EF_{p,non\ co2}$
Data unit:	tco_2/TJ
Description:	Non-co_2 emission factor arising from use of fuels in project scenario
Source of data used:	IPCC default value: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14 Global Warming Potential: http://www.ipcc.ch/publications_and_data/ar4/wg1/en/ch2s2-10-2.html#table-2-14
Value applied:	8.692
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology
Any comment:	-

Data / Parameter:	NCV_b
Data unit:	TJ/ton
Description:	Net calorific value of the fuels used in the baseline
Source of data used:	IPCC default value: http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf_Table 1.2
Value applied:	0.0156
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology
Any comment:	-

Data / Parameter:	NCV_p
Data unit:	TJ/ton
Description:	Net calorific value of the fuels used in the project
Source of data used:	IPCC default value:

	http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/2_Volume2/V2_1_Ch1_Introduction.pdf_Table 1.2
Value applied:	0.0156
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology
Any comment:	-

Data / Parameter:	$f_{NRB,i,y}$
Data unit:	Fractional non-renewability
Description:	Non-renewability status of woody biomass fuel in scenario i during year y
Source of data used:	Applicable NRB assessment conducted by C4Eco
Value applied:	0.92
Justification of the choice of data or description of measurement methods and procedures actually applied:	The NRB assessment has been carried out in accordance with the methodology. The report has been attached in the accompanying 'NRB Report' document.
Any comment:	-

Data / Parameter:	$W_{b,y}$
Data unit:	T/litre
Description:	Quantity of fuel that is used to treat 1 litre of water in the baseline scenario b during year y
Source of data to be used:	Baseline Water Boiling Test
Value of data applied for the purpose of calculating expected emission reductions	0.000900352
Description of measurement methods and procedures to be applied:	The baseline water boiling test is used to determine the amount of wood used to purify 1 litre of water by boiling. This data is gathered according to: *Technologies and Practices to Displace Decentralized Thermal Energy Consumption* Version 1*, Draft General Guidelines On Sampling And Surveys*; EB37 Annex 27; and *Standard For Sampling And Surveys For CDM Project Activities and Programme of Activities* (Version 02); EB65 Annex 2
Any comment:	

Data / Parameter:	$W_{p,y}$
Data unit:	T/litre
Description:	Quantity of fuel that is used to treat 1 litre of water in the project scenario p during year y
Source of data to be used:	Baseline Water Boiling Test
Value of data applied for the purpose of calculating expected emission reductions	0.000900352

Description of measurement methods and procedures to be applied:	The baseline water boiling test is used to determine the amount of wood used to purify 1 litre of water by boiling. This data is gathered according to: *Technologies and Practices to Displace Decentralized Thermal Energy Consumption* Version 1*, Draft General Guidelines On Sampling And Surveys*; EB37 Annex 27; and *Standard For Sampling And Surveys For CDM Project Activities and Programme of Activities* (Version 02); EB65 Annex 2
Any comment:	

Data / Parameter:	Cj
Data unit:	Percentage
Description:	Portion of users of project safe water supply who were already in baseline using a non-boiling safe water supply
Source of data used:	Baseline Study
Value applied:	0.09091
Justification of the choice of data or description of measurement methods and procedures actually applied:	Deemed valid by Methodology
Any comment:	-

Data / Parameter:	Xboil Non Suppressed Demand
Data unit:	Percentage
Description:	Percentage of premises that in the absence of the project activity would have used non-GHG emitting technologies like chlorine treatment techniques (if available) in the project boundary.
Source of data used:	Baseline study. Credible literature, studies, survey, reports, relevant to the project target area
Value applied:	0.0385
Justification of the choice of data or description of measurement methods and procedures actually applied:	Suppressed demand was determined through a set of questions in the baseline project survey that establish the method households use to purify their water, if any, and how they would choose to purify if they were not subject to monetary and access barriers. This is in line with the Gold Standard principles of suppressed demand outlined in annex 2. A fixed suppressed demand baseline has been opted for, however, in the event the project surveys show a substantial change in fuel use characteristics, a new baseline shall be conducted.
Any comment:	-

7. Monitored Parameters

As outlined in section 5.2 the following parameters are monitored in line with the methodological requirements and monitoring plan. The results are given in the parameter boxes below followed by an analysis of the surveys in section 8.

Data / Parameter:	N p,y
Data unit:	Project Technology Days
Description:	Number of persons consuming water supplied by project scenario p through year y
Source of data to be used:	Borehole Project Database

Value of data applied for the purpose of calculating expected emission reductions	GS5329: 2,493,740 GS5330: 2,459,337 GS5331: 2,412,364 GS5332: 2,373,251 GS5335: 2,227,683 GS5336: 2,129,965 GS5337: 2,085,345 GS5338: 2,002,102 GS5437: 1,911,350 GS5438: 1,791,315 GS5439: 1,615,660 GS5440: 1,573,964 GS5441: 1,416,864
Description of measurement methods and procedures to be applied:	Sum of the total number of people using each borehole in the project multiplied by the number of days crediting each borehole earns in a given monitoring period.
Any comment:	

Data / Parameter:	U p,y
Data unit:	Percentage
Description:	Usage rate in project scenario p through year y
Source of data to be used:	Annual Usage Survey
Value of data applied for the purpose of calculating expected emission reductions	100%
Description of measurement methods and procedures to be applied:	The usage survey has been carried out by staff trained by CO2balance to meet the specific requirements of the methodology. All data presented in excel is subject to checking and cross referencing of a sample of the raw data by co2balance UK Ltd
Any comment:	

Data / Parameter:	Qp,y
Data unit:	Litres per person per day
Description:	Quantity of safe water supplied in the project scenario p during the year y using the zero or low emissions clean water supply technology
Source of data to be used:	Water Consumption Field Test (WCFT)
Value of data applied for the purpose of calculating expected emission reductions	7.5

Description of measurement methods and procedures to be applied:	Method used similar to Kitchen Performance Test in which the volume of water consumed in each household is averaged over 3 days. Volume capped at 7.5 litres per person per day as per the methodology The WCFT will be carried out by staff trained by CO2balance to meet the specific requirements of the methodology. All data presented in excel is subject to checking and cross referencing of a sample of the raw data by CO2balance UK Ltd
Any comment:	

Data / Parameter:	Qp,cleanboil,y
Data unit:	Litres per person per day
Description:	Quantity of safe water boiled in the project scenario p during the year y using the zero or low emissions clean water supply technology
Source of data to be used:	Water Consumption Field Test (WCFT)
Value of data applied for the purpose of calculating expected emission reductions	0
Description of measurement methods and procedures to be applied:	Method used similar to Kitchen Performance Test in which the volume of water consumed in each household is averaged over 3 days. The WCFT has been carried out by staff trained by CO2balance to meet the specific requirements of the methodology. All data presented in excel is subject to checking and cross referencing of a sample of the raw data by CO2balance UK Ltd
Any comment:	

Data / Parameter:	Qp,rawboil, y
Data unit:	Litres per person per day
Description:	The raw of unsafe water that is still boiled after installation of the water treatment technology
Source of data to be used:	Water Consumption Field Test (WCFT)
Value of data applied for the purpose of calculating expected emission reductions	0
Description of measurement methods and procedures to be applied:	Method used similar to Kitchen Performance Test in which the volume of water consumed in each household is averaged over 3 days. The WCFT has been carried out by staff trained by CO2balance to meet the specific requirements of the methodology. All data presented in excel is subject to checking and cross referencing of a sample of the raw data by CO2balance UK Ltd

Any comment:	

Data / Parameter:	Quality of Treated Water
Data unit:	Parameters as per national standards
Description:	Performance of the treatment technology
Source of data to be used:	Laboratory Tests
Value of data applied for the purpose of calculating expected emission reductions	Pass
Description of measurement methods and procedures to be applied:	The National Water Quality Reference Laboratory has certified each water supply in line with national standards.
Any comment:	

Data / Parameter:	LEp,y
Data unit:	tCO2e per year
Description:	Leakage in project scenario p during year y
Source of data to be used:	Baseline and monitoring surveys
Value of data applied for the purpose of calculating expected emission reductions	0
Description of measurement methods and procedures to be applied:	Assessed every two years using baseline and monitoring surveys
Any comment:	

8. Survey Analysis

8.1 Water Consumption Field Test

The Water Consumption Field Test was carried out on a randomly selected sample of households from the borehole user list in line with the Gold Standard requirements. As Dowa and Kasungu Districts are monitored together, a cross sample was taken from a combined user list from both areas.

The tests were conducted between the 02/10/2017 and 17/10/2017 on a sample of 79 households. All tests were completed over the course of 4 days in October 2017 (1-day preparation and 3 days' measurement), in people's homes following a similar method as the Kitchen Performance Test. The total litres of water consumed each day was measured and divided by the number of people consuming water on that day – this measurement was repeated over 3 consecutive week days (weekdays) and an overall average per household was calculated. The results showed that on average 10.91 litres were used per person per day (capped at 7.5l).

8.2 Usage Survey

Usage surveys following the cross sampling method were conducted in October 2017 (between the 02/10/2017 and 17/10/2017). In total 100 usage surveys were conducted on a randomly selected sample of households drawn from the borehole user records. The results of the usage survey confirmed that usage of boreholes for both respondents and their family was 100%.

8.3 Project Survey Analysis

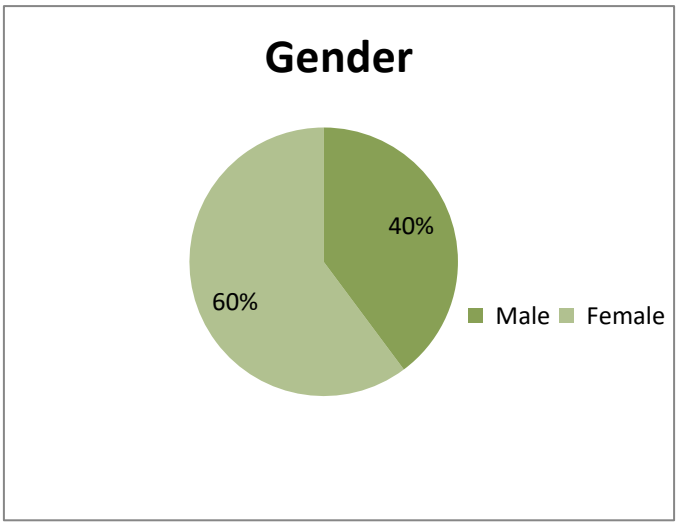
Project surveys were conducted on a sample of 108 randomly selected households from across the homogenous VPAs in Dowa and Kasungu to explore changes in the project scenario (demographics, water use and purification practices etc.) over time. Project surveys were conducted between 20/08/2017 and 30/08/2017.

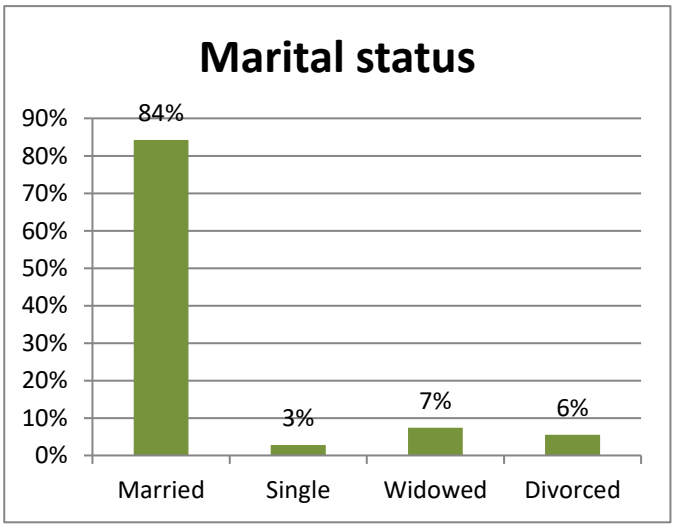
Data collected during the project surveys includes the following:

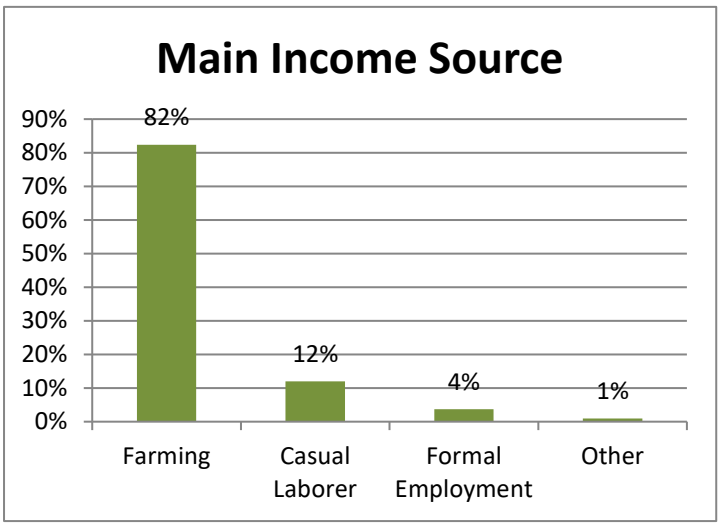
- General information - Name, address, telephone number etc.
- Household socio-demographic information.
- Water use and purification characteristics.
- Sources and availability of fuel.

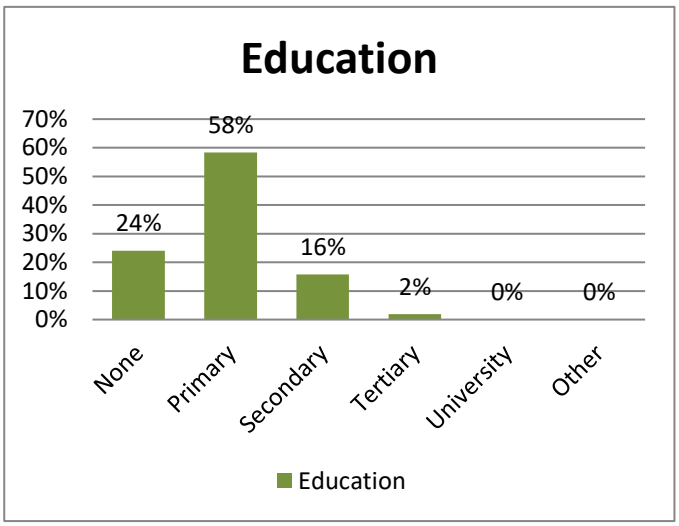
Socio-Demographic Characteristics

Analysis of the Project Survey results shows that socio-demographic characteristics such as gender is divided 40% males and 60% females in the Project Survey. 84% of respondents are married and 82% list their main source of income as farming. This is followed by casual labour at 12% and formal employment at 4%. 58% of respondents have primary level education and 16% have secondary level education. 2% of the sample have tertiary education though 24% list having no education.



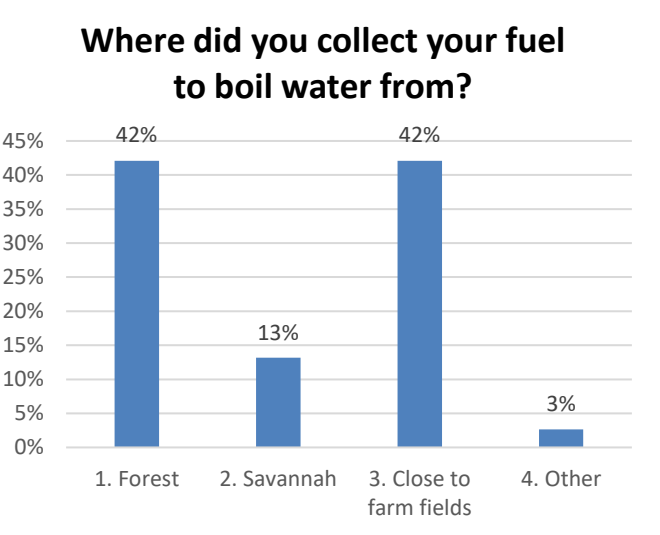


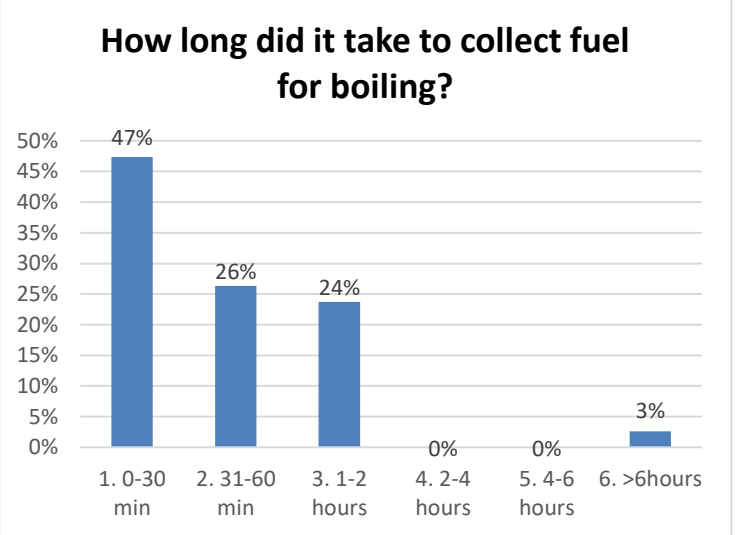




In the Baseline Survey, 93% of participants said their water is not safe to drink. The results from the Usage Survey showed that 100% of the respondents now collect their water from boreholes, which indicates a major improvement over the baseline and highlights that there is no longer a need for people to purify their water.

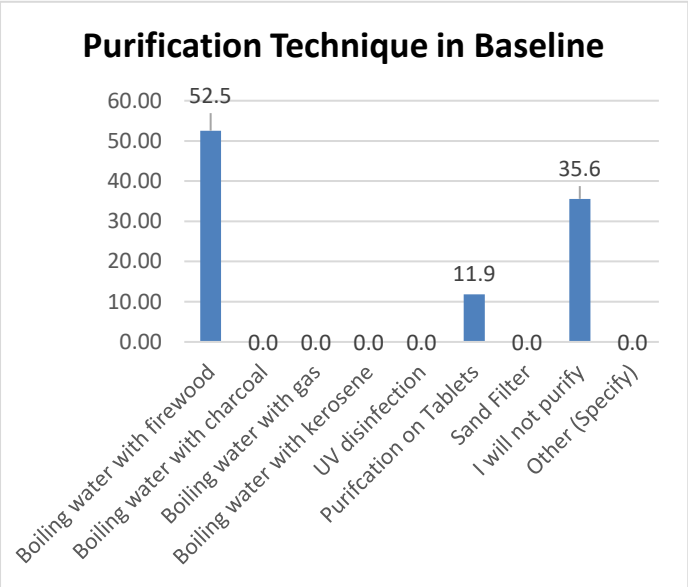
Furthermore, this creates less of a need for project participants to collect fuel in order to boil water to purify. Previous to the project, households collected fuel from the forest or close to farm fields (42%). 13% of participants collected fuel from the Savannah and 3% from other locations. This took 47% of people 0-30 minutes. A further 50% of participants could spend up to 1 or 2 hours collecting fuel. Since the introduction of the project, households don't collect fuel for water purification and save time, enabling them to pursue other economic and domestic activities.

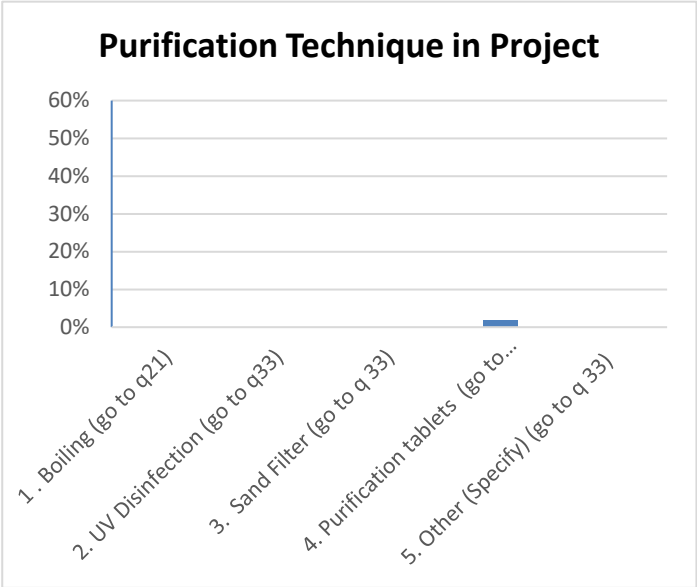




When asked what approach households use to make their water safe to drink, the Baseline study found that 52% of households boil their water as a means of purification, 12% use purification tablets and the remaining 36% do not practice any form of purification due to energy poverty.

In the project scenario, the survey shows that 98% of households no longer purify their water. 2% use purification tablets and 0% state that they continue to boil their water. This represents a reduction in pollution from burning wood to boil water and corresponds to the results of the Water Consumption Field Test.





Before the project, most households obtained their water from unsafe water sources. 19% of households collected water from a river or stream and 59% of households collected water from an open well. The results of the Usage Survey show that 100% of respondents now collect water from the borehole which is safe to drink.

8.4 Water Quality Tests

Water quality tests were conducted for all boreholes under the VPA between 01/05/2016 and 01/01/2017. The results show that all boreholes provide water at satisfactory biological, chemical and physical levels which comply with national standards on potable drinking water. This was confirmed by the respective District Water officer and the Lab Technician of the Ministry of Health.

8.5 Leakage Assessment

The potential sources of leakage listed in the methodology have been investigated, and addressed below:

a) The displaced baseline technologies are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project.

In all cases the baseline technologies displaced are three stones; these have no market value and are not a product as such. There is nothing limiting the use of three stone cooking across the country (the technology is lowest rung on the energy ladder and the price is zero), which is why this cooking method is so widespread. In any case the primary purpose of these three rocks is for cooking so they will not be replaced/displaced in their entirety as a result of this project - which means they will not be reused outside the project boundary. This leakage source can therefore be discounted.

b) The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources.

There is no evidence to suggest significant (if any) use of renewable energy for purifying water in the project region as found in the Baseline Water Surveys. As solar purification devices are not used, renewable energy used for purifying water would likely be animal dung or crop residues which will be used due to ease of availability/proximity to the home rather than due to a shortage of wood fuel, therefore it is an independent factor. This leakage source can therefore be discounted.

c) The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario.

As the majority of participants collect wood from within the project boundary, it is not expected that the NRB in other areas will be affected. There are currently no other CDM or VER projects in the project area.
d) The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology.

The space heating effect of boiling water for purification purposes will be minimal, as the predominant use of baseline technology is for cooking. Therefore it is highly unlikely that another technology will be used for heating when users no longer boil water.

e) By virtue of promotion and marketing of new technology with high efficiency, the project stimulates substitution within households who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.

This project is not marketing efficient technology; it is eliminating the need for a fuel based technology to deliver pure water. Lower emission technology substitution within households is therefore not possible and this leakage source can therefore be discounted.

Therefore, a value of 0 is applied for leakage.

Data / Parameter:	$LE_{p,y}$
Data unit:	tCO2e per year
Description:	Leakage
Source of data to be used:	Baseline and monitoring surveys
Value of data applied for the purpose of calculating expected emission reductions	0
Description of measurement methods and procedures to be applied:	Leakage will be assessed after the first verification
Any comment:	

9. Sustainable Development Indicators

The following indicators were considered of most importance to this project and were accordingly monitored:

No		1
Indicator		Air quality
Mitigation measure		None
Repeat for each parameter		
Chosen parameter		Total suspended matter (TSPM)- measured indirectly by wood consumption
Current situation of parameter		As determine by research and field staff, traditional methods used for boiling water with biomass fuel produce large amounts of TSPM. It is not justifiable to measure this quantitatively but it will measured qualitatively as described below
Estimation of baseline situation of parameter		Quantitatively, the baseline situation is one which smoke is emitted by fires used to boil water.
Future target for parameter		The project aims to reduce wood consumption and hence make a reduction in the defined parameter. This will be indicated by any reported reduction in wood fuel use in the project scenario as determined by surveys of the target population
Way of monitoring	How	Project surveys, Usage surveys
	When	Annually
	By who	Expert surveying team

Given that 100% of participants use the boreholes, there is no need to boil water for purification. As reported by the project survey, average fuel use per household for boiling water was reduced from 0.69 to 0.00 bundles of wood per week in the dry season and from 0.73 to 0.00 bundles in the wet season. Consequently, TPSM has been reduced as a result of this project and so we score this indicator positively.

10. Calculations

Baseline Emissions

$$BE_{b,y} = B_{b,y} * \left(\left(fNRB_y * EF_{b,fuel,co2} \right) + EF_{b,fuel,nonco2} \right) * NCV_{b,fuel}$$

Where:

$$B_{b,y} = \left(1 - C_j\right) * N_{j,y} * W_{i,y} * \left(Q_{p,y} + Q_{p,rawboil,y}\right) \quad (11)$$

Where:

$N_{j,y}$	Number of person.days consuming water supplied by project scenario p through year y[47]
C_j	Expressed as a percentage, this is the portion of users of the project technology j who in the baseline were already consuming safe water without boiling it
$B_{b,y}$	Quantity of fuel consumed in baseline scenario b during the year y in tons
$Q_{p,y}$	Quantity of safe water in litres consumed in the project scenario p and supplied by project technology per person per day
$Q_{p,rawboil,y}$	Quantity of raw water boiled in the project scenario p per person per day
$W_{b,y}$	Quantity of fuel in tons required to treat 1 litre of water using technologies representative of baseline scenario b during project year y, as per Baseline Water Boiling Test.

Project Emissions

$$PE_{p,y} = B_{p,y} * \left(\left(fNRB_y * EF_{p,fuel,co2} \right) + EF_{p,fuel,nonco2} \right) * NCV_{p,fuel}$$

Where:

$$B_{p,y} = \left(1 - C_j\right) * N_{p,y} * W_{p,y} * \left(Q_{p,rawboil,y} + Q_{p,cleanboil,y}\right)$$

Where:

$N_{p,y}$	Number of person.days consuming water supplied by project scenario p through year y
C_j	Expressed as a percentage, this is the portion of users of the project technology j or who in the baseline were already consuming safe water without boiling it
$B_{p,y}$	Quantity of fuel consumed in project scenario p during the year y in tons
$Q_{p,rawboil,y}$	Quantity of raw water boiled in the project scenario p per person per day
$Q_{p,cleanboil,y}$	Quantity of safe water boiled in the project scenario p per person per day
$W_{p,y}$	Quantity of wood fuel or fossil fuel in tons required to treat 1 litre of water using technologies representative of the project scenario p during project year y

Overall Emission Reductions

$$ER_y = \left(\left(\Sigma BE_{b,y} - \Sigma PE_{p,y} \right) * U_{p,y} - \Sigma LE_{p,y} \right) * (1 - Xboil)$$

Where:

$U_{p,y}$	Cumulative usage rate for technologies in project scenario p during year y, based on cumulative installation rate and drop off rate.

The results also consider the discounted fraction of non-suppressed demand users (xboil). For full calculations please see accompanying 'ER Calculations Spreadsheet.'

Baseline Fuel Use

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	
Person Days	Njy		
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	
Quantity fuel consumed in baseline scenario	Bb,y	T	

The portion of safe water users prior to the start of the project was removed from the baseline (Cj) before the amount of wood used to boil 1 litre of water (Wb,y) was multiplied by the number of litres of safe and raw water consumed per person per day (Qp,y) by the total number of project technology days (Njy). This gives the total tonnes of wood used in the baseline (Bb,y).

Project Fuel Use

Project Fuel Use (Pby)			
Portion users	Cj	fraction	
Person Days	Njy		
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	
Quantity of fuel consumed in project scenario per HH	Bp,y	T	

The portion of safe water uses was removed from the project scenario (Cj) before the amount of wood used to boil 1 litre of water (Wp,y) was multiplied by the number of litres of raw and safe water boiled per person per day (Qp) by the total number of project technology days (Njy). This gives the total tonnes of wood used in the project (Bp,y).

Constants			
NRB	NRB	Fraction	
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	
Net calorific value of fuel	NCV,b,fuel	TJ/T	

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	
Project emissions per year	PEp,y	tCO2/y	
Usage rate	Up,y	fraction	
Leakage	LEp,y	tCO2/y	
Emission Reductions	Ery	tCO2/y	

The baseline and project emissions were calculated by multiplying the amount of wood used in these scenarios by the emissions factors (EFb) for CO_2 (corrected by the fNRB value), non CO_2 and the net calorific value of biomass (NCV,b). The difference in baseline and project emissions were then adjusted using the usage rate observed in the project (Up,y)) and any leakage subtracted from the total (LEp,y).

Suppressed Demand Assessment			
Percentage of suppressed demand users			
Percentage of **non**-suppressed demand users	Xboil	Percentage	
Emission Reductions	Ery	tCO2/y	

The emissions reductions were then corrected for the levels of suppressed demand observed in the project by multiplying by (1-Xboil) to give the a total of emission reductions (ERy) for this monitoring period.

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	10,000

The maximum number of emissions reductions claimable for this VPA is limited to 10,000 for each year (detailed below). An average allowance rate of 27.40 ERs/crediting day, which corresponds to 10,000ERs/year, has been applied to ensure each VPA complies with this requirement.

11. Summary of Emissions Reductions per VPA

GS 5329

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2493740
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	15308.47791

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2493740
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	26,683
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	26683
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	25657

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	20356

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
19/12/2015 - 31/12/2016	356	356
01/01/2016 - 31/12/2017	10,000	10,000
01/12/2017 - 31/12/2017	10,000	10,000
Total	20,356	20,356

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2459337
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	15097.28606

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2459337
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	26,315
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	26315
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	25303

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	19726

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	**Total ERs**	**ERs MP1**
11/01/2016 - 31/12/2016	9,726	9,726
01/12/2017 - 31/12/2017	10,000	10,000
Total	19,726	19,726

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2412364
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	14808.92996

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2412364
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	25,812
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	25812
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	24819

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	19479

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
20/01/2016 - 31/12/2016	9,479	9,479
01/12/2017 - 31/12/2017	10,000	10,000
Total	19,479	19,479

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Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2373251
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	14568.82454

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2373251
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	25,394
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	25394
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	24417

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	18959

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
08/02/2016 - 31/12/2016	8,959	8,959
01/12/2017 - 31/12/2017	10,000	10,000
Total	18,959	18,959

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2227683
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	13675.21714

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2227683
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	23,836
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	23836
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	22919

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	18603

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	**Total ERs**	**ERs MP1**
21/02/2016 - 31/12/2016	8,603	8,603
01/12/2017 - 31/12/2017	10,000	10,000
Total	18,603	18,603

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2129965
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	13075.34954

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2129965
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	22,791
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	22791
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	21914

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	16849

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
26/04/2016 - 31/12/2016	6,849	6,849
01/12/2017 - 31/12/2017	10,000	10,000
Total	16,849	16,849

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2085345
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	12801.43795

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2085345
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	22,313
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	22313
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	21455

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	17041

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	**Total ERs**	**ERs MP1**
19/04/2016 - 31/12/2016	7,041	7,041
01/12/2017 - 31/12/2017	10,000	10,000
Total	17,041	17,041

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		2002102
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	12290.42893

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		2002102
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	21,422
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	21422
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	20599

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	16247

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	**Total ERs**	**ERs MP1**
18/05/2016 - 31/12/2016	6,247	6,247
01/12/2017 - 31/12/2017	10,000	10,000
Total	16,247	16,247

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		1911350
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	11733.32395

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		1911350
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	20,451
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	20451
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	19665

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	15452

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
16/06/2016 - 31/12/2016	5,452	5,452
01/12/2017 - 31/12/2017	10,000	10,000
Total	15,452	15,452

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		1791315
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	10996.45757

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		1791315
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	19,167
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	19167
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	18430

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	15041

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	**Total ERs**	**ERs MP1**
01/07/2016 - 31/12/2016	5,041	5,041
01/12/2017 - 31/12/2017	10,000	10,000
Total	15,041	15,041

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		1615660
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	9918.153225

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		1615660
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	17,288
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	17288
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	16623

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	13288

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
03/09/2016 - 31/12/2016	3,288	3,288
01/12/2017 - 31/12/2017	10,000	10,000
Total	13,288	13,288

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		1573964
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	9662.191378

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		1573964
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	16,841
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	16841
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	16194

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	12712

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	Total ERs	ERs MP1
23/09/2016 - 31/12/2016	2,712	2,712
01/12/2017 - 31/12/2017	10,000	10,000
Total	12,712	12,712

Constants			
NRB	NRB	Fraction	0.92000
Emissions factor fuel (co2)	EFb,fuel,co2	tCO2/TJ	112
Emissions factor fuel (non-co2)	EFb, fuel, non-co2	TCO2/TJ	8.692
Net calorific value of fuel	NCV,b,fuel	TJ/T	0.0156

Baseline Fuel Use (Bby)			
Portion using safe water	Cj	fraction	0.09091
Person Days	Njy		1416864
Fuel to treat 1 litre of water using baseline tech	Wb,y	T/L	0.000900352
Quantity safe water litres consumed in project scenario supplied by project technology	Qp,y	L/pd	7.5
Quantity of raw water boiled in addition to project technology water	Qp, raw, y	L/pd	0
Quantity fuel consumed in baseline scenario	Bb,y	T	8697.79177

Project Fuel Use (Pby)			
Portion users	Cj	fraction	0.09091
Person Days	Njy		1416864
Fossil fuel required to treat 1 litre for water in project scenario	Wp,y	T/L	0.000900352
Quantity of raw water boiled in addition to project tech water	Qp, raw, y	L/pd	0
Quantity of safe water boiled	Qp, cleanboil, y	L/pd	0
Quantity of fuel consumed in project scenario per HH	Bp,y	T	0

Emissions Reductions			
Baseline emissions per year	BEb,y	tCO2/y	15,160
Project emissions per year	PEp,y	tCO2/y	0
Usage rate	Up,y	fraction	1
Leakage	LEp,y	tCO2/y	0
Emission Reductions	Ery	tCO2/y	15160
Suppressed Demand Assessment			
Percentage of suppressed demand users			96.15%
Percentage of **non**-suppressed demand users	Xboil	Percentage	3.85%
Emission Reductions	Ery	tCO2/y	14577

Emission Reduction Cap			
Emission Reduction Cap	Ery	tCO2/y	12466

Emissions Reductions by Vintage

Emissions Reductions by Vintage		
Vintage	**Total ERs**	**ERs MP1**
03/10/2016 - 31/12/2016	2,466	2,466
01/12/2017 - 31/12/2017	10,000	10,000
Total	12,466	12,466