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MEMO ON BASELINE DATA COLLECTION ACTIVITIES June 26, 2013
Social Impact**,** Impact Evaluation of MCC Tanzania Water Sector Project

Purpose of the Evaluation
The objective of the Tanzania Water Sector Project is to promote economic growth by reducing the prevalence of water-related diseases and facilitating investment in human and physical capital. The Impact Evaluation (IE) conducted by Social Impact will measure the impact of expanding the plant capacity at the Lower Ruvu plant serving Dar es Salaam, as well as improving water supply in Morogoro through rehabilitating water treatment plants and improving water transfer in the existing distribution network.

Evaluation Design
SI has proposed the use of a rigorous, quasi-experimental evaluation design combining a difference-in-differences (DD) approach with generalized propensity score matching (GPSM), also called continuous propensity score matching. Difference-in-difference estimation of impact involves subtracting the difference in post- and pre-intervention outcomes in the comparison group from the difference in post- and pre-intervention outcomes in the treatment group. Propensity score matching (PSM) is used to strengthen the DD estimate by matching households that are similar at baseline to compare their outcomes after the intervention. PSM techniques calculate the likelihood that a particular unit of analysis, in this case the household, was selected into the treatment group (i.e., received more water from the intervention). The combination of these approaches is commonly employed in scenarios where random assignment to treatment is not feasible, as is the case with the Water Sector Project.

Generalized propensity score matching (GPSM) is an extension of traditional propensity score matching (PSM) techniques, and facilitates the evaluation of *continuous* rather than *binary* treatment. For example, since the MCC intervention is expected to result in an across-the-board increase in water availability for urban populations, the treatment cannot be accurately represented in a binary way, i.e., access to water vs. no access to water, since many households are expected to experience changes from some water to more water. Instead, it is more useful to categorize households using a continuous measure of access to water, such as average daily hours of availability. The IE design with DD and generalized PSM is therefore configured to capture the impact of observed changes across the gradient of treatment, rather than a discrete switch. The interpretation will be the average change in an outcome that can be attributed to a particular incremental change in the magnitude of the treatment (e.g., access to or availability of water).

The combination of DD and GPSM requires that SI compare baseline and end-line measurements of outcomes between households who benefited differentially from the MCC interventions for two reasons: (1) the DD estimation needs true before and after values for groups that benefit from the intervention as well as those that do not, and (2) the propensity score approach needs accurate information to match treatment and comparison households before any household has an opportunity to benefit from the intervention programs.[1] This impact evaluation design therefore requires systematic baseline data

[1] While generalized propensity score matching (GPSM) can technically be implemented post-intervention, many variables used to match these households would already have been potentially influenced by the intervention in the Water Sector Project (such as water availability and consumption), and therefore would not reflect true (pre-intervention) baseline values – in this case, they could not be used as variables upon which households are matched and the analysis would be required to construct a model predicting a household's likelihood of exposure to a given level of treatment excluding the influenced variables. In other words, the design itself is not invalidated by the change in intervention timelines, but the estimation of impact could be biased without a true baseline.

collection that can be used for matching before the intervention starts, as well as analysis of differences between treatment and comparison groups after follow-up.

Project Implementation Schedule

The intervention in Morogoro involves upgrades to two plants, Mafiga and Mambogo. At the time of negotiations with the local data collection firm in late 2012, and through early 2013, the projected completion dates for both of these intervention components were in September 2013. Baseline data collection activities were therefore planned to take place May through August of 2013, to collect baseline measures immediately before the upgrades were put into operation, and to capture both rainy and dry seasons. At the end of January 2013, MCA Water Sector confirmed with engineers in Morogoro that the Mafiga upgrades would go into effect earlier than anticipated, on April 30th, 2013 instead of September 2013. Mafiga's water represents about 75% of the system's capacity and reaches almost all areas of Morogoro, according to MORUWASA.[2] This change in the schedule of the intervention meant that baseline data on water access and quality in Morogoro needed to be collected before May 2013. All of the mini-baseline activities described below were carried out under the assumption that the Mafiga intervention starting on April 30, 2013. (Later, in May 2013 after the mini-baseline data collection was complete, the evaluation team was informed that the Mafiga intervention would not in fact begin at this earlier start date, but later in 2013 closer to the date of the Mambogo plant intervention.)

Baseline Data Collection

The baseline data collection in Morogoro had been scheduled to begin in May, and had to be adjusted in light of the intervention timing change described above. Unfortunately, it was not feasible to administer the full baseline survey in the span of only one month. Thus, SI designed a shortened baseline survey (mini-baseline) that could be administered in the full Morogoro sample prior to the intervention on April 30, 2013. The mini-baseline included an abbreviated set of questions that focus on parameters likely to change in the short term, post-intervention (e.g., water supply, use, cost, health measures). This expansion of the baseline data collection activities to include a mini-baseline phase to be carried out in April 2013 would allow SI to continue with the DD impact evaluation design using a true baseline. This enhancement to the data collection activities allows the integrity of the IE to be maintained to the extent possible, with respect to measuring impacts (and reducing potential bias) and responding to MCC's accountability objective. Many household characteristics and behaviors measured after April 30, 2013 would not have been able to represent a true baseline since they could have changed shortly after the intervention. An inaccurate baseline would compromise the inference with respect to the intervention effects, and could bias the estimated effects, in turn compromising the accuracy of the economic rate of return calculations.

Mini-Baseline in Morogoro

Given the timeline of data collection firm procurement and the assumption of an April 30th start date for the Mafiga plant intervention, the mini-baseline in Morogoro had to be carried out in a very short time period, between April 2 and April 29, 2013. The local data collection firm was procured in February 2013 and began preparations during March 2013. The purpose of the mini-baseline was to ensure that measurements are taken before the intervention has a chance to influence household water use and outcomes of interest. For this reason, the evaluation team prioritized which data were collected during this period. This priority data includes: information on primary water sources, water supply/availability (the

[2] The upgrades are projected to increase production volume from 19 to 27 MLD at Mafiga and from 4 to 6 MLD at Mambogo (volume estimates as of September, 29th 2010). It is assumed that until Mafiga upgrades are complete, approximately 19 MLD are flowing through that system. However, while proper measurement tools are not available at the plants in Morogoro, and the installation of electric flow meters is continually delayed, recent estimates have indicated that there could be up to 22 MLD flowing within the Mafiga system, according to the MCC Indicator Tracking Table (ITT). In contrast, it is also possible that during the upgrades, water levels run far below capacity, potentially as low as 50% of the baseline 19 MLD values. In addition, recent updates from MCC and MCA-T indicate that the start-date for the Mafiga intervention may be delayed to May or June 2013 rather than April 30, 2013.

primary continuous treatment variable of interest), water consumption, water expenditures, water shortage experiences, water collection time, household and system-level water quality, child diarrheal illness, school absence for children 5-18, and perceptions of major problems with water supply. In the shortened timeframe for the mini-baseline, it was not possible to capture seasonality. The mini-baseline involves the following data collection components:

- Streamlined household survey (15 minutes)
- Water quality testing at the cluster (EA) level (using household-level tests from a sub-sample of households that are surveyed; tests include fecal coliform microbial density per 100 ml and free and total chlorine)[3]
- Water quality testing at the system level (Free and Total Chlorine; Turbidity (NTU))

Full Baseline in Morogoro

The full baseline in Morogoro is planned to continue as previously scheduled (concurrently with the full baseline in Dar es Salaam, in May through August 2013). The purpose of keeping the original baseline survey timeline and plan intact is two-fold. First, the survey team will be able to collect the full range of short-term time-invariant baseline data from the households during this period. For example, we do not expect household structure, employment, educational attainment, and household composition to change substantially within the span of a few months between the mini-baseline period and the full baseline period. Therefore, we can use the full baseline period to supplement the mini-baseline with the full set of baseline data for Morogoro. The second purpose is to fulfill MCC learning objectives, and research goals of the IE. Keeping this data collection phase in Morogoro as part of the IE enables comparisons in key outcomes and matching variables across two comparison periods: (1) Baseline and Endline (April 2013 to April 2014), and (2) Immediate outcomes with partial treatment in Morogoro (April 2013 vs. May-August 2014).[4]

In contrast, in Dar es Salaam, the Lower Ruvu treatment plant upgrades are scheduled to be completed in early to mid-2014. However, these upgrades cannot be put into operation until a new transmission main is completed, and can be powered sufficiently. Official projections for the completion of the transmission main are in early 2014, but given progress on the ground, the completion is likely to be delayed further in

[3] Time and resource constraints preclude the team from carrying out free chlorine tests at the household level with the same frequency as microbial tests during the baseline data collection. Carrying out free chlorine tests at the household level would be expensive in terms of equipment and time: it would require that interviewers are trained in testing procedures, spend time at every sampled household testing the water at the site (free chlorine testing should be conducted as soon as possible after the water sample is drawn), appropriate equipment would need to be purchased, and the logistics of testing would need to be resolved. Since the information available from the microbial tests is strongly correlated with the presence of free chlorine, the fecal coliform test captures a sufficient measure of water contamination. However, EDI was able to employ a compromise during the mini-baseline. As planned, 2 water quality samples (either from household taps or community sources) were taken per Enumeration Area to yield an EA-level measure of water quality. For each household or community source test, 2 water samples were taken – 1 to be tested, and 1 for back-up (EDI has since discontinued drawing a back-up sample). The main samples were treated with sodium thiosulfate in order to preserve prevent any chlorine in the sample from continuing to kill any bacteria in the water, such that the level of bacteria at the time the water was drawn could be detected in the laboratory test. Another was taken from each EA, and not treated with sodium thiosulfate, in order to conduct one free chlorine and total chlorine test per Enumeration Area. The free chlorine tests are not reliable since they must be conducted at the point of collection immediately to be reliable, but they are done within the process of measureing total chlorine in the laboratory. More information regarding total and free chlorine tests is available from the US Centers for Disease Control (CDC) at: http://www.cdc.gov/safewater/publications_pages/chlorineresidual.pdf

[4] See Impact Evaluation of MCC Tanzania Water Sector Project Design Report for details on the methodology underlying this analysis. As mentioned earlier in this memo, the IE design is not compromised, theoretically, by the change in the intervention schedules. In other words, it is not analogous to the invalidation of an experimental design, or that it is rendered infeasible after the start of an intervention. However, without a full baseline, the impact estimates that would be made without true baseline data would be biased. The justification for continuing with the full baseline involves the collection of time-invariant data that could not fit within the time-constraints of the mini-baseline. In addition, the full baseline is not scaled down (i.e., the same information collected in the mini-baseline will be collected again in the full baseline) because of the need to measure impacts after Mafiga as well as after Mambogo.

2014. Since the intervention is being substantially delayed, the baseline in Dar es Salaam would ideally also be pushed back and data would be collected just before the intervention. However, the evaluation team decided that full baseline data collection will be carried out as originally planned, from May to August 2013, for several reasons. First, the projected deadline for the transmission main remains unclear, with estimates ranging from February 2013 until after July 2014, and additional uncertainties (such as the supply of adequate electricity to power the new plant) may pose further challenges to determining a precise deadline for project completion. Given this uncertainty, it is not possible to plan for shifting the entire full baseline, especially considering the preparation time needed in advance of the intervention start date to field the entire multi-component baseline. Second, the closure of the Tanzania Compact in September 2013 poses contractual challenges to shifting the baseline data collection; the data collection contract would likely have to be shifted to the Tanzanian Government. This process may contribute to further delays. In addition, given the original timeline stipulated in the data collection contract, substantial effort has already been directed toward the baseline activities in Dar es Salaam.

The baseline carried out between May and August 2013 will therefore provide a baseline with respect to the conditions in 2013 in Dar es Salaam, rather than just before the start of the intervention. With this understanding, knowing that some conditions can change in between baseline and the intervention (e.g., water availability or child health), the SI team has informally proposed to MCC the idea of planning another round of mini-survey data collection just before the start of the Lower Ruvu intervention in Dar es Salaam, provided there is enough advance notice (i.e., 2-3 months) before the start date, to allow for enough time to contract and coordinate with the data collection firm, and pending the availability of resources.[5] No final decision has been made about the Dar es Salaam mini-survey but MCC and SI will continue to discuss options during the baseline data collection, as additional information on the intervention schedule is made available. MCC and SI have also agreed that it is appropriate to delay follow-up data collection for Dar es Salaam until 2015, in order to allow sufficient time for outcomes of interest to manifest, given that the intervention is likely to begin sometime during the middle of 2014.

Since the intervention at Mafiga plant will not be completed as originally planned (in May 2013), the full baseline now represents a true baseline for both cities. In Morogoro, therefore, the full baseline period will now provide sufficient baseline data to be used for the IE.[6] A summary of the data to be collected in each phase, with updated timelines and activities, is shown below. A detailed version of the data collection matrix, which disaggregates each quantitative, qualitative, and direct observation method, is currently being developed and updated on an ongoing basis in a Data Collection Plan document, used internally for planning between MCC and Social Impact.

	Mini Baseline Apr 2013	***Full Baseline May-Aug 2013***	***Follow-Up (2015, TBD)***	***Household Survey***	***Water Quality Tests***	***Qualitative Surveys***	***Phone Follow-Up***	***Triangulate (Utility Data)***
MINI-BASELINE (Mor only)				**X**	**X**			**X**
Mafiga	19 MLD	19 MLD	27 MLD + Quality					
Mambogo	4 MLD	4 MLD	6 MLD + Quality					
FULL BASELINE (Mor + Dar)				**X**	**X**	**X**	**X**	**X**
Mafiga	19 MLD	19 MLD	27 MLD + Quality					
Mambogo	4 MLD	4 MLD	6 MLD + Quality					
Lower Ruvu		180 MLD	270 MLD					

[5] MCC and SI have discussed several possibilities with regard to the availability of funding for this proposed additional mini-baseline, as well as several alternative ways to contract the data collection firm for this period; no decision will be made until further information on the Lower Ruvu intervention and the feasibility of a mini-baseline becomes available.

[6] Social Impact and MCC will discuss the use of the mini-baseline data on an ongoing basis during the coming months.