The Water Smart Homes Infrastructure Works

Doing in-house plumbing repairs for the poor through public works contracts in a high dynamic environment in Zarqa Governorate – Jordan.

Field Note

MILLENNIUM CHALLENGE CORPORATION
UNITED STATES OF AMERICA

MILLENNIUM CHALLENGE ACCOUNT - JORDAN
Partners in Development

WATER AUTHORITY

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Millennium Challenge Account – Jordan:

Kamal Zoubi, Chief Executive Officer
Nazir Abu Arquob, Deputy Chief Executive Officer
Rodana Al-Dabbas, Project Director Water Systems
Sofian Qurashi, Communications and Outreach Director
Anas Hammuri, WSH-ISW Site Engineer
Ghada Al-Malouf, Communications Specialist
Khoulod Marashdeh, Social and Gender Specialist

Report prepared by:

Jorge McGregor, COWATER Field Team Leader
Malak Al-Hajaya, COWATER Field Engineer

Support team for the report:

Hiba Al-Shareef, Communications Consultant
Asma Abdalaqader, Monitoring Consultant
Basel Adaieh, Civil Engineering Consultant

Editing:

Erica Menchetti, COWATER HO Canada

Production:

Ziad Qasem, DAI Communications Specialist
Tasnim Rababaah, COWATER Field Technical Support
Mais AbuIrshaid, COWATER Field Office Manager

Millennium Challenge Account – Jordan office, Amman

86, Uqba Ben nafe'h street, Jabal Amman
Amman – Jordan
Phone: +962 6 593 6339
Fax. +962 6 593 6332
Email: info@mca-jordan.gov.jo
http:// www.mca-jordan.gov.jo

Design and layout by Jorge McGregor

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ACRONYMS AND ABBREVIATIONS

COWATER	Cowater International Incorporated
DAI	Development Alternatives Incorporated
DOS	Department of Statistics
DP	Daily Plan
DPR	Daily Progress Report
GoJ	Government of Jordan
IHWM	In-home Water Management
IPC	Interim Payment Certificate
ISW	Infrastructure Works
LoE	Level of Effort
MCA-J	Millennium Challenge Account – Jordan
MCC	Millennium Challenge Corporation
MPR	Monthly Progress Report
NAF	National Aid Fund
NEEM	Near East Electro Mechanics
NGOs	Non-Governmental Organizations
VO	Variation Order
WAJ	Water Authority of Jordan
WF	Woman Facilitator
WFC	Women Facilitator Coordinator
WP	Weekly Plan
WSHs-A	Water Smart Homes Activity
WSHs-ISW	Water Smart Homes-Infrastructure Works
WSHs-SOES	Water Smart Homes-Social, Outreach and Engineering Services
WUSP	Water and Sanitation for the Urban Poor

INTRODUCTION

This field note presents the lessons learnt from the design and implementation of the Infrastructure Works of MCA-J's Water Smart Homes Activity, funded by a Compact through the Millennium Challenge Corporation (MCC).

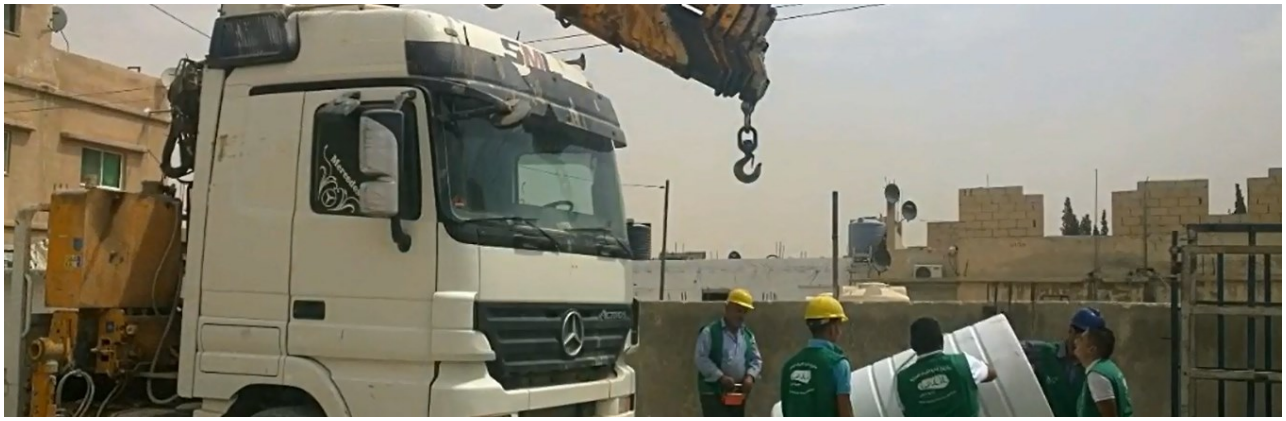
The Millennium Challenge Account – Jordan (MCA -J) is a limited liability company owned by the Government of Jordan and established in June 2010 to manage and implement a grant of 275.1 million dollars from the US Government funded through the Millennium Challenge Corporation (MCC). The Compact consists of several water and wastewater projects in Zarqa Governorate that were identified by the Government of Jordan as priority projects eligible to effectively contribute to poverty alleviation in Jordan. The program started on December 13, 2011 with a time span of 5 years.

The overall objective of the Water Smart Homes Activity (WSHs-A) is to improve the condition of home water systems and decrease costs that households, particularly poor households, in Zarqa Governorate incur to satisfy their subsistence water needs. The objectives would be accomplished through a two part initiative: an outreach campaign on in-house water management of water quality and quantity conservation; and an infrastructure component to help poor people by repairing their plumbing systems.

To design and implement the project, MCA-J signed a Social, Outreach and Engineering Services agreement with the Canadian consultant firm, Cowater International Inc., in partnership with DAI (a consultant firm from the United States of America), WSUP (an international NGO from the United Kingdom) and NEEM (an electromechanical firm from Jordan), hereinafter referred to as the Consultant.

The infrastructure works' objective was to help the National Aid Fund (NAF) beneficiaries with repairs to deteriorated in-house plumbing systems, so that the residents could properly perform in-house water management of water quality and quantity conservation, for the benefit of their health and economy.

The Consultant was contracted to do the infrastructure works (ISW) implementation design and then the administration of the ISW. The design began with a field survey of the NAF beneficiaries to establish the selection and priority criteria, as well as to determine the repair works requirement in each NAF dwelling. Based on this information, tender documents were prepared. The administration of the ISW started with the advisory services during the tender process and continued through posterior works execution.



1. BACKGROUND OF THE WSHs-A

This section is an abstract from MCA-J's Request for Proposals for the Water Smart Homes Activity – Social, Outreach and Engineering Services of February 2013.

A socio-economic survey conducted by the Department of Statistics (DOS) in 2009 revealed that Zarqa customers connected to the public system had a low perception of water quality delivered through the water network in terms of color, purity, and taste. These customers had insufficient knowledge about WAJ water quality monitoring programs, and were not aware of how water quality could change within the household system or the impact that bad sanitary habits had on its deterioration.

According to DOS survey, about 60% of people including poor households were not satisfied with the water quality of the public system. This could be attributed to perceptions on water quality from the public system and/or the condition of household water infrastructure. For the income-constrained households, the probability of purchasing bottled water and water from treatment shops was driven by potability of the public supply, while the probability of purchasing tanker water was driven by the availability of water at the household level. This brought up the need for a targeted education and awareness program focusing on household water practices to improve or maintain water potability and increase water-use efficiency.

The existing water education programs did not address the household behaviors of Zarqa residents in managing their water and maintaining its potability, instead they focused on water-use efficiency and general awareness of water scarcity. Water efficiency and scarcity awareness programs were broadcast through media channels that targeted different geographies in Jordan.

DOS data for year 2008 indicated that 26% of households in Jordan had a monthly income of less than 300 JOD. These were considered below the poverty line which was at the time estimated at 320 JOD/household/month. According to income levels in 2008, about 30% of Zarqa households fell below the poverty line while 25% of families had income of more than 700 JOD/ month. The rest of the families (around 45%) have monthly income from 320 JOD – 700 JOD.

Within Zarqa Governorate, there were approximate 11,800 households, representing nearly 7% of the population, who receive financial assistance from the National Aid Fund (NAF) with amounts ranging from 45 to 180 JOD/month. NAF is a Ministry of Social Development organization that provides financial assistance to individuals who qualify and generally represent the very poor. These households were considered among the most vulnerable in the population. Categories of NAF beneficiaries include families of orphan children, elderly and their families, families of disabled or who have humanitarian cases, women-headed households without support, etc.

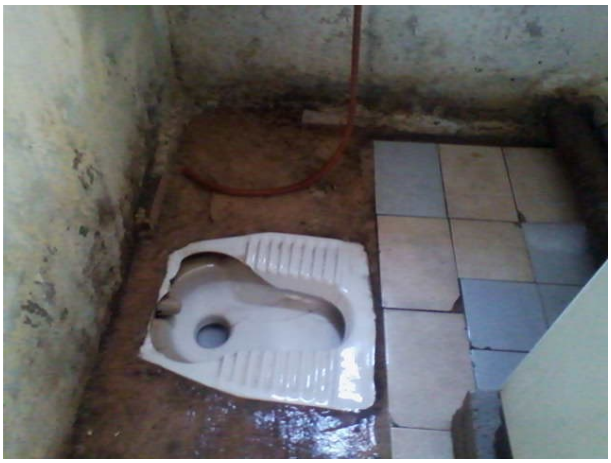
According to the referred document, women did the main share of water-related work and management, yet many didn't have a voice in household infrastructure decisions. According to DOS statistics for the first quarter of 2012, the unemployment rate for women in Jordan was higher than that for men (18% and 10%, respectively). In Zarqa, women had highly restricted access to employment and income generation. For these reasons, women-headed households were particularly vulnerable to poverty. Across Jordan, it was estimated that around 10-12% of households were led by single or widowed women. Eligibility for NAF assistance targets poor women-headed households, for example, single women, divorced women, widows, or women married to non-Jordanian men that

had no support, are eligible for NAF assistance. In Zarqa, around 21.2% of NAF beneficiaries fall within these categories and there might be other woman-headed households within the other NAF categories.

The families who earn less than 320 JOD/ household/month found it difficult to pay for household water systems replacements, and found it difficult to access existing financial instruments for household infrastructure replacement. These financing mechanisms include revolving funds which require an ability to pay back costs over time as a criterion for funding. For this reason, the existing revolving funds mechanisms target households that had an average household monthly income of more than 320 JOD.

In Jordan, women play an important role in water resources management. Governmental and non-governmental organizations alike had begun involving local communities, especially women's groups, in water resources management and water-use efficiency activities. Women's participation in water management programs were found to be highly effective in adopting and transmitting the desired messages to other community members, especially families and children.

On the household level, women and children were usually responsible for conducting water-related activities inside the house as well as gardening. While men were usually responsible for the outdoor services such as interacting with water authorities in cases of extreme water shortage and monitoring the water level in the water storage tank. This was even more evident in poor households as women usually devote the day of water supply delivery to arrange water-related activities such as storing water, cleaning, and laundry. Women's role was more difficult in cases of no water storage facilities as they store water in containers during the period of water supply to ensure that water lasted for the entire week. If they run out of water, they could borrow from their neighbors or purchase water.



2. FIELD SURVEY

According to the WSHs-SOES contract, the Consultant was to provide technical surveyors and DOS would provide the socioeconomic surveyors. Due to other DOS commitments with MCA-J, they were prevented from participating in the field surveys within the required timeframe. Therefore, the Consultant assumed the responsibility of all the field surveys.

2.1 Problem assessment

2.1.1 The database

To undertake the field survey, in December 2013, the Consultant was provided with a database containing the following information regarding 11,914 NAF beneficiaries.

- NAF Office location relevant to each beneficiary (3 Offices that serve 7 cities/towns)
- Post Office where the beneficiaries collect their monthly subsidy (19 in total)
- NAF reference file number (5 digits)
- National ID of the NAF beneficiary (10 digits)
- Full name of the NAF beneficiary (field for up to 4 names)
- Number of family members related to the NAF beneficiary (up to 13 members)
- Amount of monthly subsidy for the beneficiary (between 35-180 JOD/month)
- Type of benefit (32 different sub-categories in the database)
- Addresses (either blank, only city/town, with general landmarks or with only local landmarks)
- Telephone numbers (majority with blank cells or numbers no longer in service)

The NAF database indicated 11,914 registries in total, which initially provided the target of the number of households anticipated to be surveyed. However, subsequent analyses and information resulting from the survey itself reduced the number of target households to about 11,000 due to the following: (i) persons receiving subsidies from more than one category; (ii) more than one NAF beneficiary living in the same dwelling; (iii) people that had moved to another locality and thus were unreachable for the survey; (iv) people that had died between NAF update surveys; and (v) people that were no longer NAF beneficiaries because they received temporary benefits.

2.1.2 Problem definition

The first problem encountered by the Consultant, was how to conduct a targeted survey of nearly 11,000 NAF dwellings, in and amongst over 140,000 dwellings, in two cities and five towns, where in the majority of cases the streets had no names and the buildings had no numbers.

The common way of providing an address in Zarqa is to provide a general landmark reference (i.e. behind the municipality), and afterwards call for further instructions on how to reach the house. It is also common to provide a local landmark reference which would be known only to the people that live in that particular neighborhood, thus making it more difficult for the surveyors to reach.

This local practice made it very difficult to reach a location without an operational phone available, making it hard to do proper planning of the field survey. In the case of the NAF beneficiaries, knowing which Post Office they collected their subsidy at was no guarantee that they would live in the neighborhood in which the post office was located; nevertheless, it could provide an initial approximation for planning purposes.

The analysis of the database provided another difficulty. Even with adequate general and specific

landmarks, asking for the house of a woman (i.e. widow or divorced) in the proximity of her home could still prove to be problematic as the family names of the women would not usually be known by the neighbours (in Jordan married women do not adopt the family name of the husband).

2.1.3 The collaboration of NAF

The logical step to reach the NAF dwellings was to seek the assistance of NAF. However, at this same time they were starting their annual survey to update information on all NAF beneficiaries. This intensive period of work was carried out over a long period of time during the year, making it impossible for their staff to assist the Consultant within the timeframe for the WSHs-SOES contract.

2.1.4 Network of women's NGOs

During the needs assessment for the Outreach Campaign it was identified that there was a large network of women's NGOs in Zarqa Governorate – consisting of approximately 70 women's NGOs in Zarqa city and 40 in Russeifeh city. There was at least one women's NGO in each of the towns of Hashemeyeh, Sokhna, Dulayl, Perrin and Azraq. Some of the women's NGOs had experience doing surveys for international entities and they all worked with low income families.

A preliminary assessment made it clear that the women's NGOs could be the solution, as they could help us reach the NAF beneficiaries with whom they worked, and search for others through the tribal organizations and refugee camp administrations. The only NAF beneficiaries that they would likely not be able to find at a high proportion, would be women NAF beneficiaries living in high income neighborhoods (i.e. New Zarqa).

2.2 Field survey strategy

The strategy decided upon to locate the NAF beneficiaries and perform the field surveys was to use the services of local women from the women's NGOs network to locate and perform socioeconomic surveys in Zarqa and Russeifeh. They would work with the male plumbers that would perform the technical surveys for the repair works requirements in the NAF dwellings.

In the towns of Hashemeyeh, Sokhna, Dulayl, Perrin, and Azraq, local women NGOs partnered with local plumbers in order to carry out the socioeconomic and technical surveys of NAF beneficiaries.

The survey was conducted in stages to draw lessons from the previous surveys. The sequence would be: first Zarqa, second Russeifeh and third, the other five localities in parallel.

This strategy meant training a minimum of 30 local women to perform socioeconomic surveys in Zarqa, then another 30 in Russeifeh, and then the proposed local women by the women's NGOs in the 5 towns.

2.3 ODK technology

The approach used during the survey involved the nature and method of data collection (via the questionnaires) by use of an Open Data Kit (ODK) platform. ODK is a suite of tools that was developed around 2009 to make data collection more efficient and accurate by using mobile phones as the data entry platform (as opposed to clipboard, pen and paper).

The ODK platform specifically developed and implemented for surveys allowed the surveyor to transmit the data through a mobile phone network from the surveyor to the Consultant home base. This was key to maximizing effectiveness in providing data in real time from almost any location to home base (provided mobile coverage existed). The questionnaire, created in a digital form on the phones and tablets utilized by the team in

the field, was directly linked to a central database which aggregated all the data received.

The surveyors used smartphones with an ODK platform for mobile devices, which allowed quality control and quality assurance (QC/QA) on a daily basis. It also provided the surveyors with the ability to determine the GPS coordinates of the dwellings, and to take pictures of the household water systems, in order to have a better understanding of the needed repairs.

The benefits of using ODK

The use of the ODK platform approach to perform the survey was an overall positive experience as planned, in particular with regard to the efficacy of the team's data collection and collation, and for quality assurance, a key aspect of the surveys. The real-time data availability was invaluable in terms of allowing immediate adjustments to survey team mobilization, as well as ensuring consistency in surveyor responses. The use of ODK is highly recommended for similar field survey work and should not be limited to this aspect only.

Using an ODK platform tool can maximize the efficiency of the data collection as well as ensure an adequate level of quality control on the data being collected.

2.4 Survey Questionnaire

Two questionnaires were used in each household, the first being the Socio-economic Questionnaire which aimed at preparing a profile of the households; and the second being the Technical Questionnaire which consisted of observations and questions aiming to identify household infrastructure needs. The following sections were covered:

Socio-economic questionnaire:

- General information;
- Socio-economic situation;
- Economic burden due to poor water and sewage services; and
- Satisfaction with water and sewage services.

Technical questionnaire:

- General information;
- Description of water and sewage systems;
- Roof water storage tank problems;
- Ground water storage tank problems;
- Pipe connection from meter to tank problems;
- Water pump problems;
- Water distribution in-house problems;
- Kitchen sink problems;
- Bathroom basin problems;
- Toilet problems;
- Sewage system in-house problems;
- Sewage system exterior problems; and
- Septic tank problems.

During the survey, these two questionnaires were completed at each household in parallel by a team composed of a social-economic surveyor (woman) and a technical surveyor (man).

2.5 Planning

2.5.1 Team Mobilization and Coordination

Examination and evaluation of several mobilization scenarios for the survey implementation resulted in a planned execution in three stages beginning with Zarqa, then Russeifeh and followed by the other five localities in parallel (Dulayl, Sokhna, Hashemeyeh, Azraq and Perrin).

In total the field survey activities were estimated to take 11 weeks. During the last week of field activities two teams would be available to do additional

"clean up" field surveys in Zarqa and Russeifeh; to deal with situations where households that could not initially be located were subsequently identified and/or in the case of households where occupants were absent at the time of the initial visit.

2.5.2 Survey Team Profile

The socioeconomic and technical surveyors' education and skill profiles, through driven by clear requirements necessary to undertake the work, were also influenced by the local available resources in Zarqa Governorate. As discussed, the reality of the sensitive nature of the survey work in terms of obtaining socio-economic data in particular meant that the origin of the surveyor (whether or not from the local area) was also a consideration. The following minimum profile was established and met for the recruitment of the survey team.

Socioeconomic surveyors:

- Gender: female
- Education: completed 12th grade
- Experience: participation at least in one previous survey
- Living: Zarqa/Russeifeh/other 5 localities as needed
- Other: familiar with smartphones

Technical surveyor

- Gender: male
- Education: completed 8th grade
- Experience: five years of working experience as a plumber
- Living: Amman/Zarqa/Russeifeh
- Other: familiar with smartphones

2.5.3 Training of the Survey Team

Socioeconomic surveyors:

The training of the socioeconomic surveyors of Zarqa and Russeifeh was performed over a one week period, with the final day being joint training with the technical surveyors. The training covered the following topics:

- **1st day:** Purpose of the survey and route planning
- **2nd day:** Procedures of the field survey and conflict resolution
- **3rd day:** Socioeconomic survey questionnaire
- **4th day:** Use of ODK and Android Platform
- **5th day:** Practical joint exercise in the morning and clinic in the afternoon

Technical surveyors:

The training of the technical surveyors was performed in 5 days in Zarqa City, and with the final day consisting of a practical joint exercise with the socioeconomic surveyors. The training covered the following topics:

- **1st day:** Purpose of the survey and water and sewage systems description
- **2nd day:** Problem identification on subsystems and quantities determination
- **3rd day:** Technical survey questionnaire and exercises
- **4th day:** Use of ODK and Android Platform and exercises
- **5th day:** Practical joint exercise in the morning and clinic in the afternoon

2.5.4 Field Test

A field test of the survey was performed in Zarqa over two days prior to the planned start of the field survey (i.e. a "test run"). During the test run 25 teams were deployed and reached an average

effectiveness of 15 surveys per team over two days. As a result of issues encountered in the use of the ODK platform, adjustments and enhancements were made to the training devoted to the use of the platform.

2.5.5 Quality Assurance and Quality Control

Quality assurance

The socioeconomic questionnaire contained certain questions that were meant to be cross referenced to ensure/verify the consistency of the data collected, such as reported income vs reported expenditures. Similarly, the technical questionnaire also contained certain questions that were cross referenced to determine the consistency of data, such as the reported length of piping from a roof tank vs reported height of the building. Between the socioeconomic and technical questionnaires, the responses to key questions where designed to be cross referenced to determine the internal consistency of the data collected (i.e. storage capacity from socioeconomic questionnaire vs observed water tank capacity from the technical questionnaire). The daily process to ensure the quality of data is summarized as follows:

If inconsistencies were identified within the socioeconomic surveys the Social and Gender Specialist was notified and would then confer with the supervisors and socioeconomic surveyors to verify the inconsistency.

If inconsistencies were identified within the technical surveys the Project Engineer was notified to contact and discuss the inconsistency with the foreman and the technical surveyors in order to determine its cause.

If inconsistencies were identified within the cross referenced socioeconomic-technical surveys the Field Engineer was notified to determine the source of the inconsistency directly with the socioeconomic and technical surveyors.

If needed, the survey was performed again by a supervisor and the foreman.

Quality control

Quality Control was led by the Team Leader assessing, on a weekly basis, the performance of the Social and Gender Specialist, the Project Engineer and the Field Engineer with regards to following the Quality Assurance process. This was done by an in-depth independent analysis of the results of a random sample of survey results after merging the three databases: socioeconomic, technical and NAF.

2.6 Survey Reach

From the NAF database provided to the Consultant of 11,914 NAF beneficiaries it was determined that they represented 11,019 NAF dwellings. This was done after eliminating the NAF beneficiaries receiving more than one subsidy and the dwellings in which more than one NAF beneficiary lived. Of these, a total of 8,206 NAF dwellings were reached. The table below provides a summary of the number of surveys undertaken, broken down by city/town.

Location	Target	Surveys	Percentage
Zarqa	4,492	3,453	76.87%
Russeifeh	4,714	3,078	65.29%
Azraq	297	282	94.95%
Dulayl	599	504	84.14%
Hashemeyeh	379	351	92.61%
Perrin	145	145	100.00%
Sokhna	393	393	100.00%
Total	**11,019**	**8,206**	**74.47%**

As can be seen from the table, reaching the NAF beneficiaries in the towns was more effective. This was due to the fact that in the towns the presence of the tribal organization was stronger and more concentrated that in the cities.

During the survey a percentage of NAF beneficiaries were identified as having moved to another locality, or moved abroad, or being recently deceased. Additionally new NAF beneficiaries were identified, which was reasonable due to the dynamics of the NAF beneficiaries in the Governorate.

2.7 Selection and priority criteria

The results of the field survey determined the selection and priority criteria for eligible beneficiaries.

2.7.1 Selection criteria

It was determined that to be eligible to receive the WSHs-ISW benefit, all three of the following conditions should be fulfilled:

The dwelling of the NAF beneficiary should need repairs to the in-house plumbing systems that were affecting the water quality and/or quantity management (meaningful not cosmetic repairs); and

The NAF beneficiary should have a total income from all sources that place him/her under the pov-

erty line, and as such their limited incomes could not address these needed repairs; and

The NAF beneficiary accepts the commitment to sustain the WSHs-ISW benefits.

Of the NAF dwellings surveyed, there were a total of 5,198 NAF dwellings that fulfilled the eligibility criteria. It should be noted, that of the three conditions, the first criteria was the main cause for non-eligibility, as the dwellings were in no need of repairs.

2.7.2 Priority criteria

The 5,198 eligible NAF beneficiaries represented a total of 14,290 individual persons receiving a subsidy from NAF (i.e. a woman headed family with two children would receive 3 subsidies while a family with a handicapped individual would receive only one subsidy for the handicapped child).

To determine the prioritization of these 5,198 eligible NAF beneficiaries relative to each other, a set of criteria was proposed and analyzed with regards to overall effectiveness for fairness, transparency and to meet the goals of the WSH-A. They were as follows:

Vulnerable groups:

- Elderly persons with dependent families
- Head of households with a disability
- Families with handicapped members

Gender:

- Women-headed families with no support
- Widows with no support
- Divorced women with no support
- Single women with no support

Tenure:

- Dwellings owned by NAF beneficiaries
- Dwellings owned by NAF beneficiaries' families

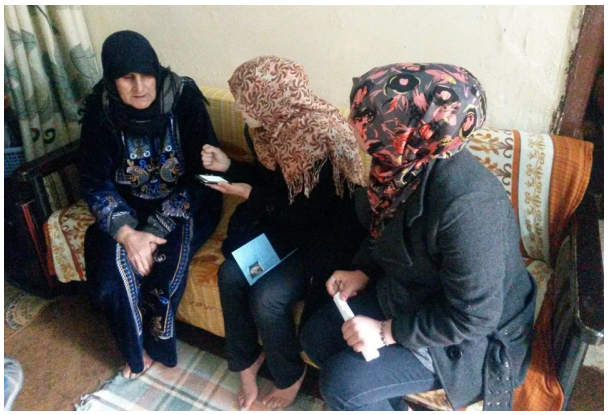
Socioeconomic:

- Family type (nuclear or extended)
- Number of family members living in the household (HH)
- Monthly expenditures per HH member
- Use of additional sources of water accessed by the HH
- Head of HH unemployed
- Head of HH education level

Technical:

- Families without water storage tanks
- Families with high degree of urgent repairs
- Repair cost

The weighing of each criterion was determined by the vulnerability of each group and the focus to aid as many NAF beneficiaries and their families as possible. The most relevant factors were determined to be the absence of water storage tanks, the degree of urgency of the repairs needed, and the use of additional sources of water.



3. TENDER DOCUMENTS

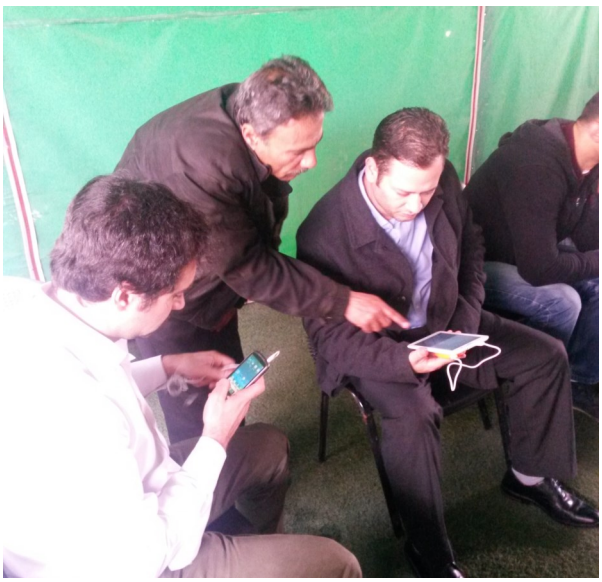
that they should be executed as public works, the tender documents constituted a particular challenge.

3.1 Problem assessment

The field survey was made during March-May 2014, and it was determined that the works execution would likely begin one year after the technical survey, due to the time needed for design, approvals and the tender process itself.

After the assessment of the results of the field surveys the following problems were identified:

1. 27.4% of the NAF beneficiaries were elderly people and it may be expected that some of them might pass away between the field survey and the works execution.
2. 24.6% of the NAF beneficiaries lived with their nuclear families in rented house paying between 20 and 100 JOD/month. It was determined that this segment of the potential beneficiaries had the highest mobility; so it was likely that some of them may move by the time the works execution started.
3. 8.9% of the NAF beneficiaries were female between the age of 18 to 35 years and were single, divorced or widows. It was probable to assume some of them will have married and moved by the time the works execution started.
4. 7.4% of the NAF beneficiaries were likely to be receiving temporary benefits due to the nature of the categories in which they were allocated (i.e. families of prisoners and detainees); so it was likely that some of them may not be NAF beneficiaries at the time of the works execution.
5. 1.9% of the NAF beneficiaries that didn't have water storage tank lived in rented houses; so the installation of a permanent water storage tank could affect them negatively through a rental increase or by being forced to move.
6. 63.1% of the NAF beneficiaries spent less than 5 JOD/month on house maintenance, mostly electrical; so it was likely that in some of the houses the works requirements might have increased by the time of the works execution.
7. Due to the proximity of Zarqa to Amman, the existence of Syrian refugees in the governorate, and the resilience policies of the donors aligned with the government of Jordan's priorities, the activity of international and national NGOs had significantly increased in the target areas. The NGO activities included aid to poor people to improve their living conditions, including aid for house repairs.
8. The examination of the pictures of the different repairs needed that the technical surveyors took during the field survey, (over 24,000 pictures) showed a wide variety of kitchen and bathroom appliances; so decisions needed to be made with regards to the standardization of the appliances to be used for replacement.
9. The pictures also showed roof water tanks in-



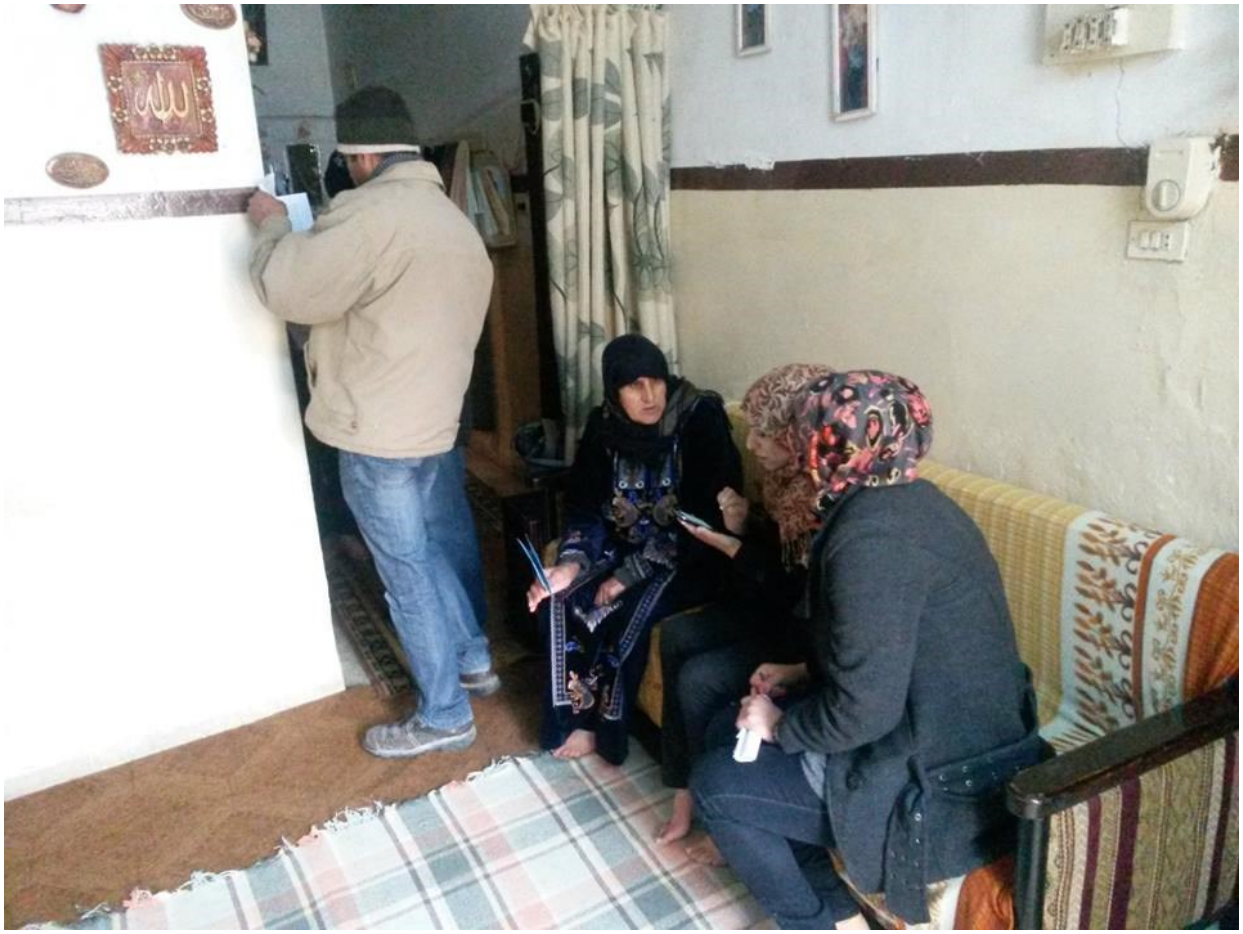
stalled in precarious conditions that could make it impossible to replace them without jeopardizing the structure of the roofs; thus, alternatives should be considered to meet the needs of these NAF beneficiaries.

10. From the examination of the pictures it was evident that there would be accessories that would need a determination on-site to determine their replacement or not; thus, procedures should be put in place for a quick decision on these issues during the works execution.

11. 37.0% of the NAF beneficiaries were women that lived with no adult male in the house (husband, father, uncle or brother). For cultural and security reasons, these women would unlikely accept the presence of a construction crew composed exclusively by men, unless they could get a male family member or friend present during the works execution.

12. The works contracts would have to be executed on multiple construction sites; therefore, multiple site possessions and works acceptance would need to be made, due to the norms for public works.

13. The NAF dwellings would be occupied during the works execution. 62.6% of the NAF beneficiaries were either elderly or had disabled members of the family, so the intervention cy-



cle in their dwellings, including addressing observations from failed works inspections, should be performed in short periods, so as not to disturb the life of the NAF families.

14. The addresses collected by the socioeconomic surveyors often used the traditional way of indication (i.e. behind the Municipality or near the school NNN), because the NAF beneficiaries are accustomed to providing their addresses in that way.

15. 28.8% of the NAF beneficiaries surveyed didn't have operational phones at the moment of the field survey and 16.3% spent less than 5 JOD/month in communications (including cellphones). The average life-span of a cellphone number of a NAF beneficiary was less than 12 months, and the cellphone line availability (operational and non-operational) had an average life-span of 3 months. In Zarqa, in the absence of street names and building numbers, people rely on cellphones to receive instructions on how to reach a house.

16. The coordinates that the technical surveyors had taken had an average error of less than 40m; nevertheless, the small and medium Contractors in urban areas, likely to be hired for the works execution, were not accustomed to using coordinates.

17. There were no public works Contractors in the area with experience in works of this nature (over 1,200 different sites and with occupants present). Even the Maintenance Contractors that worked with the Ministries of Education and Health were accustomed to working in schools and health centers when they were unoccupied. They were also used to working on a limited number of construction sites. There was concern that they would not know how to do a proper costing when preparing their proposals.

18. To perform on multiple construction sites with a specific intervention cycle and a short period of time on each site, the Contractors would need high logistic and administrative skills, and have a steep learning curve; thus, the replacement of a Site Engineer in the middle of the works execution would be of high risk.

In summary, the Consultant had to create tender documents for a set of works that were usually done by individual plumbers or NGOs; with NAF beneficiaries that could be replaced; with a Bill of Quantities that would be fluid due to the dynamics of the NAF beneficiaries and their dwellings; and with over 1,200 multiple construction sites in each contract, located in cities and towns with no street names and building numbers. For Contractors with no previous experience in this type of work, who were not accustomed to using coordinates in urban areas, who would likely not know how to do proper costing in these circumstances, and with English as the official contractual language, they would face significant challenges.

3.2 Strategy

To deal with the identified problems the following strategy was put in place while developing the tender documents:

1. The contract would be a unit price contract due to the uncertainty of the quantities that would be contained in the Bill of Quantities.
2. The works execution would be tendered in several packages to allow the possibility of several Contractors. This would avoid the risk of a single non-complying Contractor and allow for the possibility of having another Contractor complete the works within the timeframe of the project.

3. The construction crews would have to include a woman facilitator in each crew to gain access to the NAF dwellings, and performing different tasks before and during the repair works at each site.

4. The field survey report would be included in the tender documents in order for the Contractors to have a better idea of the nature and conditions in which they were expected to perform the works and to help them do a proper costing.

5. Design an intervention cycle on each construction site that would disturb the NAF beneficiaries as little as possible while the repair works were under execution.

6. Include a stage in the intervention cycle where the supervision team would perform a verification of the items and quantities to be executed in each NAF dwelling.

7. Develop the tender documents in a flexible way that would allow for the potential of adjusting the work cycle according to the observed reality in the field during the works execution.

8. The technical specifications would have to use the most common appliances and accessories used in NAF dwellings, keeping the highest standard possible to avoid rejection from the NAF beneficiaries.

9. Include in the tender documents that the Consultant would provide the work forms for the sites based on coordinates, and using addresses and phone numbers only for secondary reference.

10. The work forms would be provided by the Consultant after the works contract was signed, enabling the Consultant to substitute the NAF beneficiaries as required due to moving, death, or repairs no longer being necessary.

11. Ensure that of the key staff of the contractors there was a minimum number of assistant engineers, women facilitators and a woman facilitator coordinator, with their specific roles and responsibilities defined.

12. Schedule training for all Contractor key staff so that they would know the nature and particularities of the intervention cycle and works execu-

tion, as well as learning how to work with coordinates.

13. Include in the tender documents a Procedures Manual and an Environmental, Health and Safety (EHS) Plan in English with a translation in Arabic to be used as reference.

14. During the pre-bid meeting, emphasise the nature of the works to be executed and the particularities of the contract.

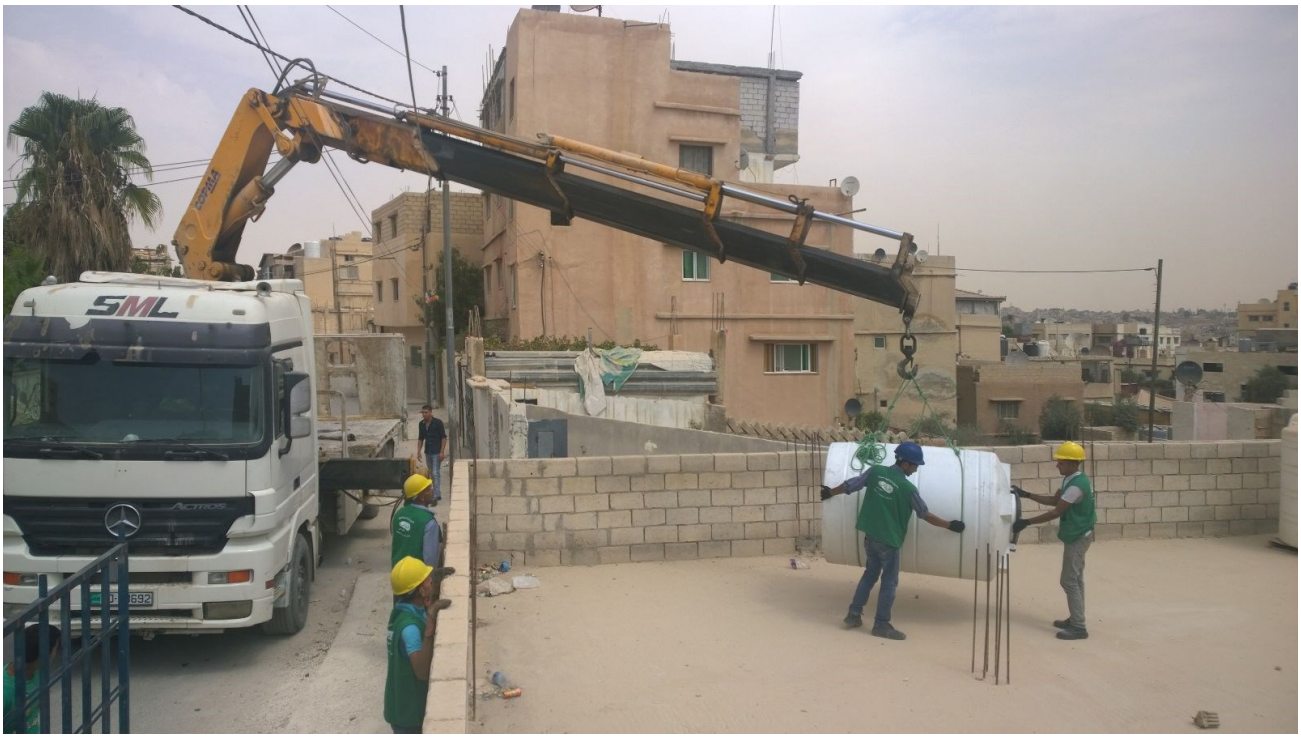
15. Schedule an orientation meeting with the Contractors prior to the start date of their contracts to provide a general orientation on the intervention cycle, the need to use coordinates, a training schedule for key staff, and financial procedures related to tax exemptions of the works contracts.

16. The contractual time period was set for 13 months, 1 month of mobilization and run-tests and 12 months for works execution, estimating an average 100 repairs/month. The time estimated was very conservative because of the anticipated learning curve to do the works properly.

While developing the tender documents the Consultant analyzed the dynamics of the NAF beneficiaries list of the governorate and concluded that the list could have approximately 500 of the NAF beneficiaries removed because they died, moved or ceased to be NAF beneficiaries. As the NAF database provided to the Consultant was elaborated in mid-2013, it was likely that there would be over 1,200 new NAF available for additional surveys during the works execution if needed. These new NAF would likely have more updated addresses and operational phone numbers.

3.3 Procedures manual

The objective of the procedures manual was to



regulate the relations and interactions between the Contractors, Consultant, NAF beneficiaries, and MCA-J, under the policies of the Millennium Challenge Corporation (MCC) and the applicable laws and bylaws of the Kingdom of Jordan.

The procedures manual covered the following topics:

- NAF beneficiaries' eligibility
- Implementation work plan
- Works contract procedures
- Consultant – Contractor coordination
- Environmental, Health and Safety plan, and
- Grievance/complains procedures.

The procedures manual was written in simple and plain English, and was translated to Arabic for referential purposes.

3.4 EHS plan

The objective of the Environmental, Health and Safety Plan (EHS Plan) was to establish the framework needed to ensure the safety and good health of employees involved in the construction activities, the project beneficiaries and the general public.

In order to do so, the main causes of risks were identified based on the works to be conducted, and mitigation measures were detailed to ensure safe work procedures. Sections of the EHS plan provided a review of relevant laws and regulation, a description of the works and associated hazards, risk and mitigation measures, emergency response and reporting procedures, roles and responsibilities, monitoring, and lastly guidelines for working in and with households.

3.5 Market study and technical specifications

As previously indicated, the revision of the field survey pictures showed that there was a large dispersion of models of kitchen and bathroom appliances and accessories. It was a challenge to determine the standard models to be used as it had to take into account the NAF beneficiaries' acceptance as well as market availability from a single provider (i.e. the project replaced over 500 kitchen sinks).

To develop the technical specifications the steps followed were:

Group discussion with the technical surveyors to determine by consensus which were the most frequent appliances and accessories (type and model) used in the NAF dwellings.

Where there was no consensus within the technical surveyors, the Project Engineer and Field Engineer would revise the field survey pictures and propose the most common type and model to be used that would fit the existing installations, choosing the best alternatives to avoid rejection by the NAF beneficiaries (i.e. single basin versus double basin kitchen sink).

After the determination of type and model, the Project and Field Engineers would do a market study to determine their availability (in the needed stocks) and average price to be used in the Engineer's Cost Estimate.

With the confirmation of availability in the market, the Project and Field Engineers would draft the technical specifications.

When revising the pictures of the field survey a particular problem was seen regarding the exterior water piping. A high percentage of horizontal exposed piping was of PVC material and vertical exposed piping was of PEX. Neither type is specified to be used on exposed exteriors due to their poor resistance to ultra violet rays. The decision was made to use galvanized steel piping as this

material complies with the standard specifications for exteriors and interiors, due to their higher resistance to impact.

3.6 Tender process

The tender was divided into four packages. The Contractors would be allowed to submit proposals for all the packages; however, only two packages would be assigned to a single Contractor. The packages were:

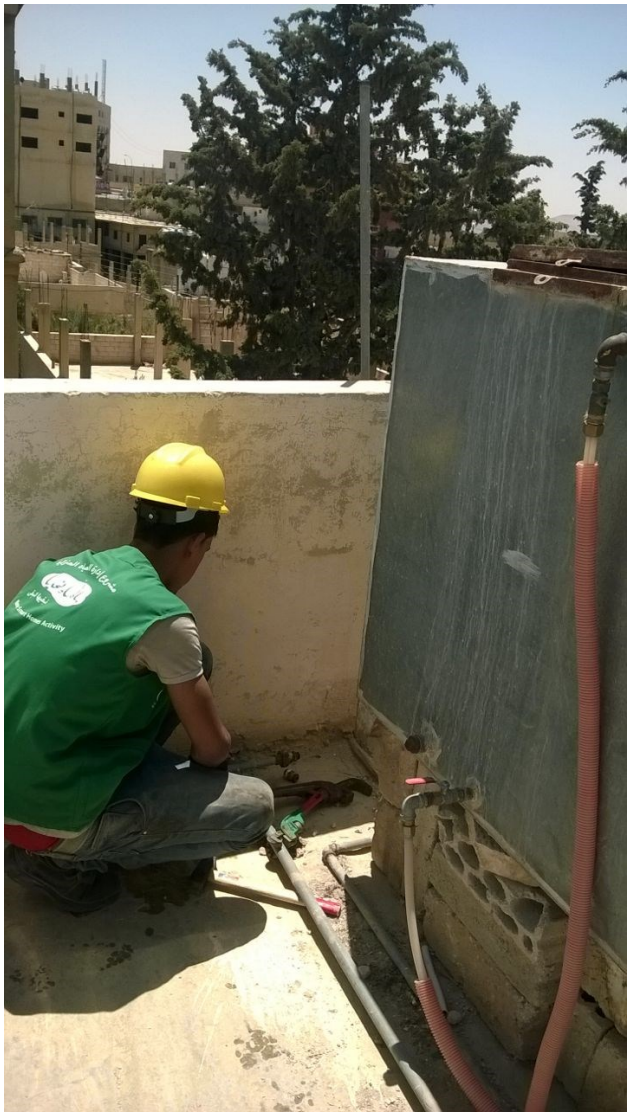
- Package 1: Russeifeh
- Package 2: Russeifeh and Zarqa
- Package 3: Zarqa
- Package 4: Zarqa, Hashemeyeh, Dulayl, Sokhna, Azraq and Perrin.

The packages had an average of 1,300 HH and an average estimate cost of USD 950,000. Package 4 was the most expensive due to the dispersion of the localities.

As foreseen, the range of proposals was very large, ranging from one million up to over two million US dollars. Each Contractor dealt in a different way with the uncertainty of the procedures and lack of reference to do the costing of works.

Due to the price of the proposals it was decided to execute only the first three packages. During the negotiation of package 3 it was decided to include some NAF beneficiaries from Hashemeyeh and Sokhna, aiming to have 3 packages serving over 4,000 NAF beneficiaries. The final number of beneficiaries was to be determined once the revised quantities and new NAF works requirements were established during works execution.

The tender process started on December 2014 and the works contracts started on May 2015 after 12 months of the field survey. With a one month mobilization period the works execution would start 10 days before Ramadan.



4. WORKS EXECUTION

The three works contracts started on May 10, 2015 and were scheduled to end on June 9, 2016. The lessons learnt from the process were many, and focused on works at multiple construction sites of non-common nature.

4.1 Scope of the works contracts

The three works contracts had the same clause referring to the scope of work, with the only variation being the approximate number of dwellings to be repaired. The number was referential because it was a unit price contract.

"The Works consist of in-house repairs/ repositions/renewal of the plumbing systems of approximately XXXX dwellings. The works will be focused in: (i) water storage systems, (ii) exterior water piping, (iii) interior water piping, (iv) exterior sewage systems, (v) interior sewage systems, (vi) kitchen and bathroom appliances, and (vii) connection to WAJ sewage system.

During the execution of the works in each dwelling the Contractor will give in-house water management awareness sessions of water quality and quantity, and provide basic plumbing maintenance training. For this task the Contractor will incorporate in each repair team a local women facilitator that will be trained by the Engineer to give the awareness sessions and do the basic plumbing maintenance training. The Contractor will give the women facilitators in-job training in plumbing to improve their skills to perform the trainings."

The Contractors understood the first paragraph of the scope of work; nevertheless, it took them some time to assimilate the fact that the second paragraph was also part of the scope of work, and its non-compliance would have consequences. Once the Contractors understood this, they increased the minimum number of women facilitators to be able to accelerate the works execution.

4.2 Intervention cycle

The following text was in the tender documents in the section "V-2 WORKS REQUIREMENTS, TECHNICAL SPECIFICATIONS AND PERFORMANCE REQUIREMENTS" that constituted an integer part of the works contracts.

"These Procedures have been established in response to the particular nature of the repair works that will be performed by the WSHs-ISW component which involves a large number of construction sites with relatively small cycles of work required in each household.

The work cycle for each household will be as follows:

- *Site possession, where the NAF beneficiary opens the house for the repair works to be executed and signs the acceptance agreement.*
- *Measurement Forms, where the Engineer establishes the real quantities of work to be executed in the dwelling following the on-site possession with the contractor's representative.*
- *Safety Checklist, where the Engineer verifies the Contractors' compliance to the Environmental, Health and Safety Plan.*
- *Works execution, where the Contractor executes the works (as adjusted by the Measurement Form process and updated Works Form), and the women facilitators perform the training on in-house water management and basic plumbing maintenance.*
- *Works Inspection, where the Engineer verifies that the repair works have been done according to the technical specifications, drawings and general good engineering practices.*
- *Works Reception, where the NAF beneficiary accepts the repair works that have been per-*

formed by the Contractor.

The work cycle can take from a few hours to several days, depending on the nature of the repairs indicated in each Works Form for the household. This obliges the Contractor to have a good logistic plan and a high level of coordination with the Engineer.

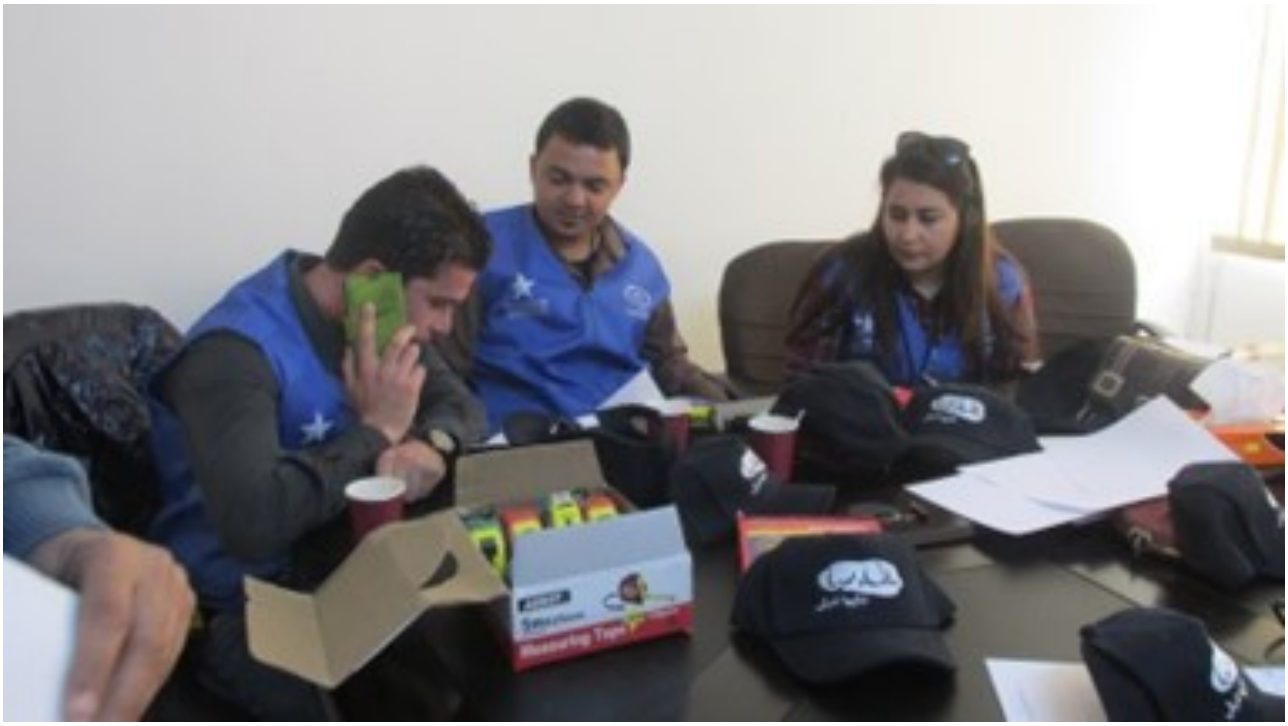
Due to this fact, and the possibility of changes to the final quantities of some items (increases or decreases) it will be of the utmost importance that the Contractor establish adequate unit prices to cover all the contingencies and dead times involved. For this reason, as indicated in the process, the Price Contingency evaluation will be very important to ensure the contractors unit bid prices (not just the total bid price) are in line with realistic market values and logistical requirements should increase quantities of work be identified during the site possession."

The aforesaid section specified the following field organization of the Contractor to be able to cope with the intervention cycle.

"The Contractor will thus have the following field organization:

- *One Site Engineer*
- *Two Assistant Engineer - one for each 4-5 work teams*
- *One Foreman*
- *One Women facilitator coordinator*
- *One Woman facilitator for each work team*
- *Plumbers as needed*
- *Assistant plumbers as needed*
- *Non-skilled workers as needed*
- *Auxiliary and support staff as needed.*

The Site Engineer, the Assistant Engineer and Women Facilitator Coordinators must be fluent in



the English language given that the Reports of the WSHs-ISW Contracts will be in English.

The Contractor shall assemble work teams consisting of one plumber, one woman facilitator and assistant plumbers and non-skilled workers as needed to perform the different tasks."

These sections of the tender documents were included in the Procedures Manual that was translated to Arabic and included as referential information.

4.3 Supervision technology

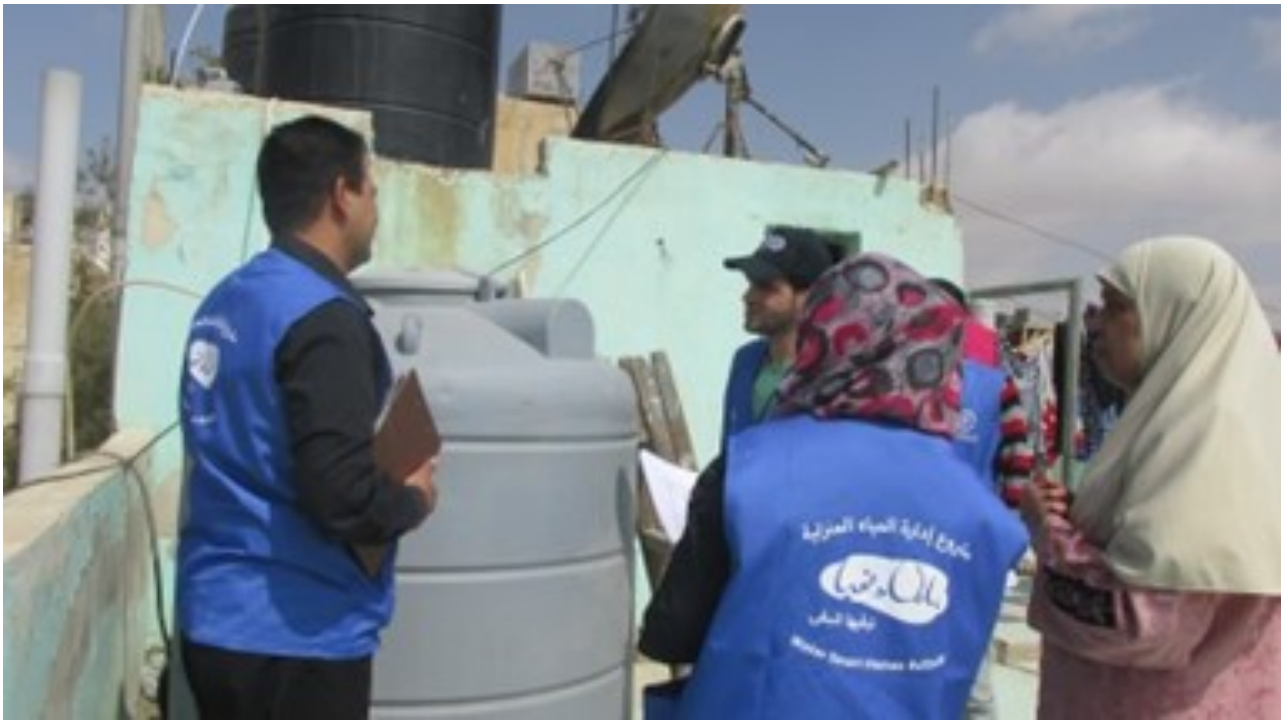
The supervision team was headed by the Field Engineer, directly responsible for nine supervisors (civil and mechanical engineers), one EHS inspector (civil engineer), one technical support (information systems) staff member and non-technical support staff.

To manage the work of over 4,000 construction sites, each with an individual Bill of Quantities and a six step intervention cycle, it was decided to use Tablet PCs running MS Windows and an application developed in MS Access.

This application had all the electronic forms that would be needed during the intervention cycle, and the supervisor would be able to collect the signatures of the NAF beneficiaries and Contractor's representatives for later printing and distribution. The application had safety sub-routines to reduce the possibility of errors while entering the data in the field.

On a daily basis the supervisors would send the database information and our technical support would merge them, to be used to monitor the progress of the works execution. The databases of the three contracts would be used by the Project Engineer to revise the Contractor's invoices.

The design of the application was linear and designed for a one stage continuous process, which meant that the same supervisor would go through



the full intervention cycle in a given NAF dwelling. After the test-run the intervention was made into a two stage process: (i) site possession and measurement forms; and (ii) works execution, works inspection, works acceptance. The EHS compliance inspection was separately performed by an EHS inspector.

During the test-run it was determined that the Tablet PCs were not adequate to perform the quantities verification activity, due to the fact that data was often being entered from roof-tops and in the sun, where the screen was not adequately visible. The Tablet PCs were replaced by printed forms for the first stage of the intervention cycle, and the supervisors would enter the data at the site offices.

The substitution of a double stage process instead of the single stage one gave the Contractors the capability to accelerate their work, because having a stock of site possessions and verified quantities enabled them to hire more crews to work in more sites per day, but also demanded from them a higher degree of planning to which they were not accustomed. The Contractors had to provide a Daily Plan for the activities that were to be executed the following day in order for the Field Engineer to plan the work of the supervisors.

4.4 Trainings

The Consultant performed several trainings for the staff of the Contractors, grouped in the following way:

- Site Engineers, Assistant Engineers and Women Facilitator Coordinators jointly for the three contracts. These trainings were on the intervention cycle, the role of the key staff, tasks of the woman facilitators in the intervention cycle, planning and reporting. This training was done in English.
- Women Facilitator Coordinators were trained on the use of coordinates, planning, reporting, QC/QA of the work of the woman facilitators, awareness sessions on In-House Water Management (IHWM), training on basic plumbing maintenance, conflict resolution and avoidance, grievance procedures and training as trainers of the new woman facilitators. This training was done in English.
- Woman Facilitators were trained on the scripts to be used in the different stages of the intervention cycle, communication skills, awareness sessions on IHWM for NAF families and neighbors, training on basic plumbing maintenance to the NAF beneficiaries, conflict resolution and avoidance, grievance procedures and reporting. This training was delivered three times due to low attendance at the first training and the turnover of the woman facilitators. This training was done in Arabic.
- All the staff of the Contractor, including Foremen, Plumbers, Assistant Plumbers and non-skilled workers, was trained on the EHS plan and its compliance, as well as first aid procedures. This training was done in Arabic.

Additionally, the Contractor had the contractual obligation to do on-the-job training for the woman facilitators in order for them to better deliver the training on basic plumbing maintenance to the NAF families.

4.5 Test-run

The test-run took place during the mobilization period and served to determine the performance of the teams ‘supervisor - assistant engineer - woman facilitator’ to perform site possessions and quantity verification, as well as to troubleshoot on the procedures, so that the Consultant could issue complementary field procedures within his con-

tractual attributions.

During the test-run the Contractors requested the Consultant divide the single stage process into a two stage process, allowing them to have an adequate stock of site possessions and measurement forms (with the verified quantities) to better plan their logistics and works execution.

With the variations in quantities information that the measurement forms were providing, which showed in some cases a significant variation both up and down, the Consultant agreed to the request. However, due to the deterioration of the plumbing installations in some cases, and in-home repairs already made by the beneficiaries (usually with the aid of NGOs) in other cases, this two stage process would demand a higher level of planning from the Contractors.

4.6 The woman facilitators

The woman facilitators were a key element of the works contracts due to their responsibilities in the intervention cycle and to deliver the awareness sessions to the NAF beneficiaries and their neighbors. The awareness session was part of the interpersonal communication channels of the outreach campaign. See the field note 'The Water Smart Homes Outreach Campaign' that describes the communications strategy and achievements of the woman facilitators.

The works contracts established:

"Due to the nature of the repair works to be performed in each household and the local culture and practices, the Contractor shall incorporate in each work team a local woman as a facilitator and one woman as overall facilitator/coordinator. The Contractor shall include in the unit prices of his proposal this additional cost.

The local women facilitators will have the following responsibilities:

- *Contacting the NAF beneficiaries to coordinate the initiation of the repair works and guarantee the presence of NAF beneficiary neighbors during the repairs;*
- *Coordinating any special needs that the NAF beneficiaries would require during the execution of the repair works;*
- *Training the NAF beneficiaries and their neighbors on in-house water management and basic plumbing maintenance while the repair works are under execution; and*
- *Conflict resolution between the NAF beneficiaries and the work teams that may arise."*

The overall performance of the woman facilitators was good; they were reliable and contributed to inform about the sites in which works execution was underway. Seven ladies of the Woman Plumber Program of the project joined the Contractors as woman facilitators. This was a positive addition to the teams that helped them better integrate their work with the male construction crews. See the field note 'The Water Smart Homes Woman Plumber Program' that shows the trainings received to be women plumbers.

4.7 Learning curve

The learning curve of the three contracts was different.

Case 1: The Contractor started during Ramadan with small repairs, studying the performance of the construction crews and learning lessons that were applied adequately after Ramadan to increase the level of activity. The Site Engineer and the Women Facilitator Coordinator (WFC) learnt to work jointly and interdependently to plan the activities of the plumbers and the woman facilitators.

Case 2: The Contractor started during Ramadan with small repairs and attempted water tank installation in small houses. However there was little mitigation of errors that was evidenced in the Daily Progress Reports. The Site Engineer and the WFC worked as separate units and lacked symmetry in the level of organization of work between them. This was reflected in the Daily Plans.

Case 3: The Contractor started after Ramadan trying to action a large number of site possessions and measurement forms before starting works execution. When the works execution started they were on an accelerated pace that gave the Contractor no time to learn from errors. This resulted in a higher than expected number of failed work inspections.

4.8 Performance of the Contractors

In general terms the overall performance of the Contractors was satisfactory with a slow learning curve due to field staff turnover and understanding of the scope of work. For a proper understanding of the scope, MCA-J played a fundamental role. The bulk of the works execution took between 7 and 9 months, and required the Contractors in all the cases, to revisit NAF dwellings to perform awareness and training sessions, to fully complete the scope of work.

Planning

The Contractors had to submit the following planning instruments:

- A Weekly Plan (WP), to communicate the scheduled activity (site possession & quantity verification, works execution, works inspections) for the following week. This would help the Consultant to program the Level of Effort (LoE) required from the supervision team. Based on this information the Contractor should contact the NAF beneficiaries to schedule appointments for the following week. This plan should be submitted by noon of the last

working day of the week.

- Daily Plan (DP), to communicate the scheduled activities to start/continue the following day. This allowed the Consultant to prepare the forms that would be needed for the next day. This plan was required to be submitted the previous day by 3 p.m.

The contents of the Daily Plans and the delay in their submission showed that during the first stage (site possession and quantity verification) the Women Facilitator Coordinators were performing and had control over their team of woman facilitators. The second stage planning showed that the Site Engineers were not receiving timely information about the works execution and became dependent on the information that the plumbers gave them at the end of the day.

The lack of adequate information on the DPs was resolved by the supervision team by permanently coordinating with the woman facilitators by telephone, as each construction crew had to incorporate one woman facilitator to be present all the times in the NAF dwelling while the repair works were being done.

In the beginning, through random calls to the NAF beneficiaries, there was evidence that some crews were performing works execution without a woman facilitator in NAF dwellings with a male head of family. Though the presence of the woman facilitator was secondary if the male head of family was present, she was still required to deliver the awareness sessions to the NAF family and neighbors, and provide training on basic plumbing maintenance.

Reporting

The Contractors had to submit the following reports:

- Daily Progress Reports (DPR), where they had to record the progress of the work performed the previous day (social and technical), on staff, vehicles and equipment, material, and incidences occurred during the reported day.

- Monthly Progress Report (MPR), where they had to summarize the information of the DPR and report on a set of indicators, both social and technical. The MPR should be submitted by the 5th day of the following month.

The social contents of the DPR (site possessions and quantity verification, awareness and training sessions) was the responsibility of the WFC, while the technical contents of the DPR (works execution, works inspections, works acceptance and the logistic and administrative segments) was the responsibility of the Site Engineer. They showed that while the WFC had adequate control over her set of responsibilities, the Site Engineers had less control. The latter was evidenced with the lack of accuracy of the reported information (i.e. reporting works execution on sites that already had works acceptance) and the delays in their submission.

The DPR was cross-referenced between the social and technical sections as well as with the daily

reports of the supervisors, which showed the inconsistency of the reported information.

The MPR had to be submitted to support the Interim Payment Certificates (IPC) of the Contractors; nevertheless, it had the same problems as the DPRs, as it reflected the summary of the information of the DPR.

Material approval

To avoid shortage of material stocks, the Contractors could submit for approval up to three brands/ models of each material for approval. The water storage tanks and the pipes had no problem in the submittals and approvals; nevertheless, with the appliances and accessories there were some problems.

After the first approval of material, the Contractors sometimes switched to the use of different brands/ models, indicating that the Contractors were looking for items on sale. The new brands most often fulfilled the technical specifications, this determination was made after the samples and catalogues were submitted for approval, but as they were not previously approved, they failed the works inspection.

The problem ceased when the Contractors realized that they could submit up to three different brands or models for approval for each material.

Failed works inspections

The rate of failed works inspections was higher than expected, having sites that failed up to three times the works inspections. The main reasons for the failed works inspections were due to the use of non-approved material and poor work execution.

It was found out after speaking with the plumbers, that they were paid by job. If they wanted to make more money they would do quicker repairs. When the plumbers reported that the work was done the Site Engineer (SE) requested a works inspection where little quality control had been done by the Assistant Engineers (AE). After a failed works inspection there was little communication between the AE and the plumbers about the cause of the failure.

The problem was reduced when the SEs realized that the lack of control over the works executed by the plumbers was affecting their invoicing. After this they started exercising more quality control and integrating the plumbers in the works inspection process, so the plumbers would know exactly why the inspection failed.

EHS compliance

In general terms the compliance of the EHS plan was reasonable, having no accidents reported during the works execution on approximately 4,000 construction sites.

EHS inspections were performed randomly by the EHS inspector on a daily basis, using the following procedure:

1. Based on the DP of the Contractors, the inspector would determine the sites with more safety risk operations, basically those lifting water storage tanks, fitting exterior piping, and heavy appliance installation.
2. After selecting the high risk sites, the inspector would coordinate with the WFC to know which woman facilitators were assigned to the chosen sites.
3. The inspector would then call the woman facilitators to get precise directions to reach the sites and schedule the inspections.
4. When confronted with a high risk operation

without safety equipment and provisions, the inspector would stop the works until the safety equipment was on the site and being properly used.

5. When confronted with a low risk operation without safety equipment, the inspector would note the infraction and report it. Recurrent minor infractions would lead to sanctions.

4.9 New NAF

As it was foreseen during the planning stage with the information of the field survey, there was a need to perform additional surveys to new NAF beneficiaries to substitute the NAF beneficiaries that had died, moved, made their own repairs, refused the assistance of the project or could not be located. In total there were almost 1,000 new NAF recipients that were in the category of having no need or not reached (moved with no reference to their new location).

Location of new NAF

In order to identify and/or locate NAF beneficiaries, three methods were used:

- Coordination with NAF agencies
- Post Office survey
- Requested collection in the field by Contractor, Consultant and Client

The Post Office survey proved to be the most adequate source of information for updated locations of new and existing NAF beneficiaries.

The NAF beneficiaries collect their subsidies during the first days of a month in the Post Offices. With the help of the PO administration, a survey was scheduled to be held in November 2015, during the first five days of the month, with the participation of 25 local surveyors trained for that purpose.

The operation served to collect updated addresses and operational cellphone numbers of approximately 3,000 NAF beneficiaries; being that over 1,400 corresponded to new NAF that were not in the NAF database 2013.

Substitution procedures

To determine if the new NAF fulfilled the selection criteria, a short socioeconomic survey was designed to provide the needed information to apply the selection and priority criteria.

A group of 4 surveyors was trained to do phone surveys using the proper introductory speech and questionnaire. During the survey a more precise location would be obtained based on three landmarks (area, direction and block) and noticeable characteristics of their buildings.

With the results of the socioeconomic survey, the selection and priority criteria were applied. After performing approximately 1,400 socioeconomic surveys, a list of around 1,000 potential new NAF was established and technical surveys scheduled. The technical surveys were performed by the supervisors using the standard technical forms. If the technical survey indicated that the NAF dwelling needed repairs, the technical forms would be used as measurement forms and provided to the Contractor for works execution.

4.10 Infrastructure Outputs

By the end of the works execution period, the Contractors had executed repairs in 3,958 NAF dwellings. The infrastructure outputs of the NAF beneficiaries are shown in the table below.

Item	Description	Output
1	**Improved water storage capacity**	
1.1	Replacement of water storage tanks of 2 m3 or 1 m3	1,225 Tanks
1.2	Supply and installation of new water storage tanks of 2 m3 or 1 m3	1,447 Tanks
1.3	Supply and installation of new water storage tanks of 500L or 250L	448 Tanks
1.4	Female NAF beneficiaries that have improved water storage capacity	1,537 Tanks
1.5	Male NAF beneficiaries that have improved water storage capacity	1,581 Tanks
2	**Leakage repairs in water pipes**	
2.1	Replacement of 3/4" water piping (meters)	3,714.70m
2.2	Replacement of 1/2" water piping (meters)	16,077.00m
2.3	Female NAF beneficiaries that have leakage repairs in water pipes	8,024.00m
2.4	Male NAF beneficiaries that have leakage repairs in water pipes	11,767.70m
3	**Kitchen and bathroom repairs**	
3.1	Kitchen and bathroom repairs per-formed in NAF beneficiary dwellings	3,958 dwellings
3.2	Female NAF beneficiaries that have kitchen and bathroom repairs	2,134 dwellings
3.3	Male NAF beneficiaries that have kitchen and bathroom repairs	1,824 dwellings
4	**Training on basic plumbing repairs**	
4.1	NAF families that received training on basic plumbing repairs	3,712 families
4.2	NAF women that received training on basic plumbing repairs	3,054 women
4.3	Number of tool kits for plumbing repairs distributed to NAF families	3,958 toolkits

5. LESSONS LEARNT

The Water Smart Homes Infrastructure Works provided important lessons on how to reach and perform repair works in occupied poor people's houses, in localities with no street names and building numbers, with Contractors that had to deal with works that were not familiar in nature.

5.1 Field Survey

Without the field survey the project would not have started. The success of the field survey was the results of the creativity of the local multidisciplinary teams of the Consultant and the client, and the collaboration of the different social networks of Zarqa Governorate.

5.1.1 Finding locations through social networks

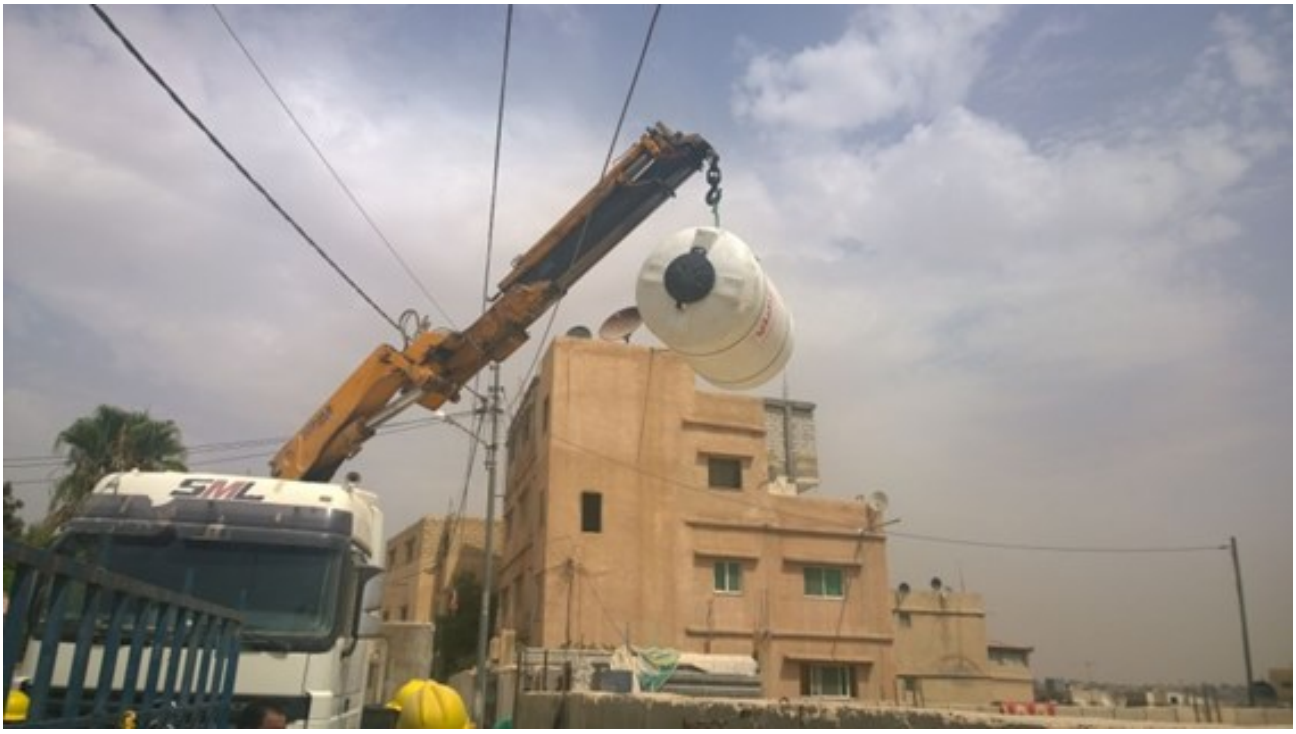
Everybody belongs to different social networks, the key to find a specific group of people is to create a profile for them, to do the appropriate social network mapping of the community, and to select the most efficient networks available.

In the case of the NAF beneficiaries it was feasible to reach 74.47% of the database in 11 weeks of field work, using the network of the women's NGOs, tribal organizations and Palestinian camp administrations.

It would have been feasible to reach more NAF beneficiaries with more time available for the field work, but as in all projects there is a timeframe.

5.1.2 Breaking social and cultural barriers

To use teams of male and female surveyors in a conservative society such as Zarqa and Russeifeh cities was not easy. By using local women's NGOs in the towns of Hashemeyeh, Dulayl, Sokhna, Azraq and Perrin the problem was eliminated, because the NGOs would contact local plumbers that were family or friends of the surveyors.



The policy of zero tolerance with respect to the behaviour of the technical surveyors in their relations with the socioeconomic surveyors contributed breaking these barriers. Any kind of disrespect or use of coarse language in front of them was not tolerated. The socioeconomic surveyors started trusting the technical surveyors and felt protected by them.

5.1.3 ODK technology

The use of ODK technology contributed positively to the success of the field survey by: (i) enabling the monitoring of the progress of the surveyors in the field; (ii) taking coordinates of the locations with an adequate level of error (40m in average); (iii) enabling the properly filing and organization of over 24,000 pictures of the work requirements; (iv) performing quality assurance in a timely manner; and (v) organizing high volumes of data coming from the field surveys.

5.1.4 Using local women as socioeconomic surveyors

The network of women's NGOs in Zarqa has a lot of experience performing surveys with local women for international entities, has credibility within their community and can provide surveyors of different profiles.

In the particular case of the field survey they provided local women that were familiar with specific neighborhoods of Zarqa and Russeifeh, and with previous experience in social surveys. This made the training of the questionnaires and scripts easier.

The requested profile included familiarity with the use of smartphones and social media, which made the training on the use of the ODK application simpler.

5.1.5 Using plumbers as technical surveyors

The plumbers used as technical surveyors needed a specific profile. They had to be local so that they would be more familiar with the neighborhoods. They had to be familiar with the use of smartphones (to enter data, manage coordinates and take pictures), to have experience in assessing repair works, to have the physical ability to climb to roofs in some cases, and to have the communication skills to obtain the support of the NAF beneficiaries when needed. In Zarqa and Russeifeh it was not feasible to recruit all the required plumbers (25 in total), so some of them had to be recruited from Amman.

5.2 Works Execution

Without the creativity, commitment and flexibility of the Field Engineer and her Supervision Team, as well as without the knowledge and experience of the Project Engineer, the works execution would have not reached the desired outcome. Success

was also due to the collaboration of the Contractors and in particular to the excellent work performed by the Women Facilitator Coordinators.

5.2.1 Mobility of NAF beneficiaries

The mobility of the NAF beneficiaries was larger than expected; approximately 1,000 NAF beneficiaries from the original list were replaced by new NAF beneficiaries, which represented 25% of the final works executed.

Between the three contracts there were a total of 803 NAF beneficiaries in the category of 'no need' because they had died, moved out of the work contract areas, or made their own repairs or refused the assistance of the project. In the latter case it was usually because it was a rented house.

There were over 200 NAF beneficiaries that could not be reached, mainly for two reasons. The first was related to women headed families with no operational phone number available. In this case the neighbors and nearby businesses would not recognize the family name of the woman, usually asking for the family name of the children (that was not available). The second reason was usually related to rented houses, where the neighbors that recognized the families didn't know where they had moved.

To avoid this need for substitution, a program should be designed in such a way whereby repairs could be made soon after survey of the beneficiaries, as occurred with the new NAF. Future project of this nature should weigh the convenience of having a "demand drive" versus "need based" approach for its implementation.

5.2.2 Supervision technology

The development of an application based on MS Access proved to be an adequate supervision tool to manage the volume of information generated

from the construction sites; nevertheless, when the single stage process was transformed into a two stage process it required several adjustments.

The key lesson learnt is to develop flexible modules that will better adapt to new experiences that require test runs; in particular after a lot of time and effort have been expended training a supervision team.

5.2.3 Test-runs

It is of the utmost importance to do test-runs of the designed procedures in front of works that have a non-conventional nature.

In front of the results of the test-run, the single stage process originally designed for the intervention cycle was modified to a two stage process. This allowed the works execution to be completed in less time.

5.2.4 Learning curve

When confronted with an unfamiliar scope of work, the Contractors had a slow learning curve. The acceleration of the learning process depends on the understanding of the Site Engineer of the scope of work and his/her willingness to learn.

A key element to the learning process was the understanding of the Contractor of the key driver for his economic success. Once they realized, in this case, it was the work of the woman facilitators and quality control over the work of the plumbers, there were less errors and failed inspections.

5.2.5 Incorporating women in construction crews

Due to the particular nature of the works to be performed it was important to incorporate women in the construction crews. This incorporation proved to be the right decision; the women facilitators contributed positively to the success of the project and provided support for the supervision activities.

The on-the-job training that the woman facilitators received during the works execution in basic plumbing maintenance has incentivized some of them to perform these tasks within their family and social networks.

The achievements of the woman facilitators as an interpersonal communication channel of the outreach campaign were impressive, not only through the number of women reached through their awareness sessions, but also due to the spread of the messages through ‘word of mouth’.

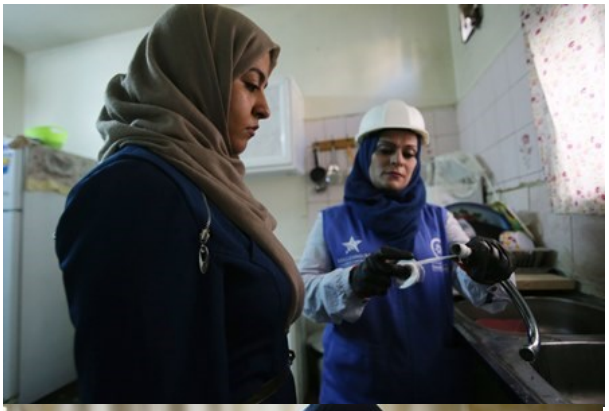
5.2.6 Site Engineers and Women Facilitator Coordinators

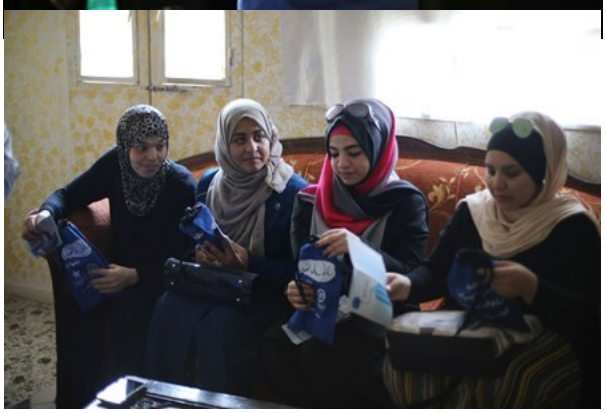
Initially the profile of the WFC established a background in social sciences; nevertheless, at the end

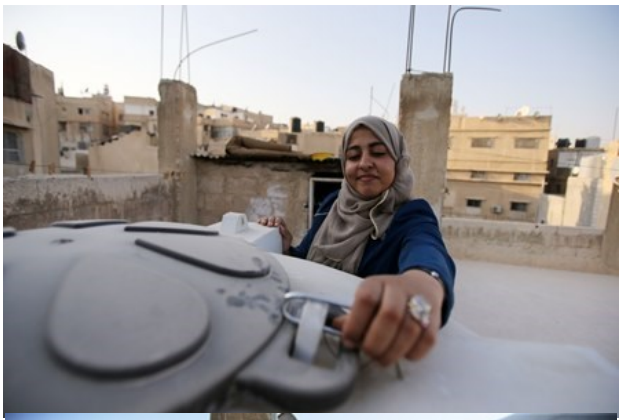
all the WFCs were engineers with good leadership skills. This proved to be of high relevance because they could better communicate with the Site Engineers, which enabled them to better cooperate and plan.

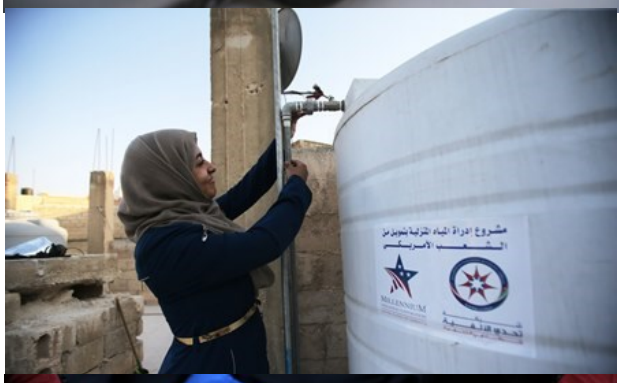
5.2.7 Performance of the Contractors

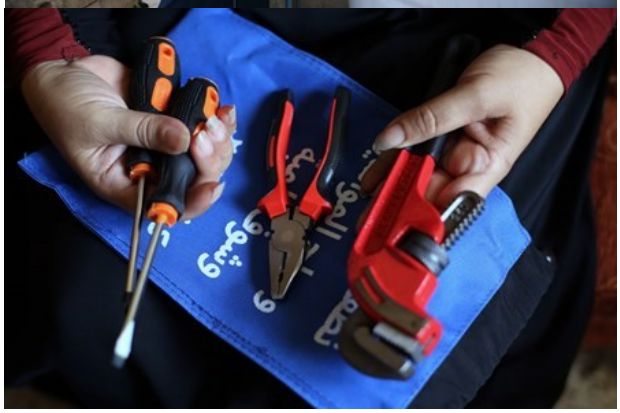
The Jordanian Contractors proved capable of performing works of unfamiliar nature. However, the Site Engineers that were recruited for small works continued to have problems when confronted with new situations in planning, reporting and quality control. This led, in turn, to a high percentage of failed works inspections. In future, key elements that the Consultant must take in account to properly enhance the performance of the Contractors.











Millennium Challenge Account – Jordan

86, Uqba Ben nafe'h street, Jabal Amman
Amman – Jordan

Phone: +962 6 593 6339
Fax. +962 6 593 6332
Email: info@mca-jordan.gov.jo
http:// www.mca-jordan.gov.jo

MILLENNIUM CHALLENGE CORPORATION
UNITED STATES OF AMERICA

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