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WASH FIELD NOTE FN/21/2019

Piloting a field-based Water Quality Test for E. coli – lessons from Afghanistan

SUMMARY

The quality of water, whether used for drinking, domestic purposes, food production or recreational purposes has an important impact on health (WHO 2013). In 2016 in Afghanistan, the Central Statistic Organisation (CSO) integrated a Water Quality Test (WQT) Module in the ongoing Afghanistan Living Conditions Survey (ALCS) to assess the current water quality situation in rural and urban communities at source and household level. The objective of this pilot was to assess the current water quality based on the E. coli risk levels and to assess the WQT training module and whether the WQT should be integrated in future LCS in Afghanistan. With support from UNICEF, the enumerators working for the ALCS were thoroughly trained in the use of the WQT and implementation of the tests took place in 10 provinces. The results of this pilot were twofold: the WQT revealed that in many communities, particularly in rural areas, water was often heavily contaminated at the source level (34% at high/very high risk levels of E. coli) and these risk levels increased at the household level (47% high/very high levels of E. coli). Yet, the results from piloting the WQT training module and the possibility of integrating this module in future ALCSs was seen to be positive by both the enumerators and the participating communities. Undoubtedly, the country and its inhabitants would benefit from the rolling-out of the WQT in their surveys as to further identify E. coli risk levels of water sources in Afghanistan.

Introduction

For decades, *use of an improved drinking water source* has been the main indicator for water programs around the world. Recently however, sector professionals have increasingly regarded this indicator as misleading; although use of an improved water source is an indicator of access to water, it is not an indicator of the **water's quality**. Water from an improved source (an improved source refers to water collected from a household connection, public standpipe, borehole, protected well or spring, rainwater collection and packaged or delivered water) can still be of poor quality, due to among others, the poor maintenance of the service, the use of inadequate water transportation containers, or risky storage of the water at the household level.

Today, the newly accepted benchmark under Sustainable Development Goals (SGD 6.1) is **safely managed drinking water services**, meaning that *drinking water is from an improved water source located on the premises, available when needed and free from faecal and chemical contamination* (JMP, 2017).

UNICEF WASH programmes have taken this information into serious consideration and are moving towards a water safety framework for programming, where Water Safety Plans (WSP) including water quality tests (WQT) will become an integral part of the new framework. In Afghanistan, pilot experiences have been developed for both the integration of WSP and

Picture 1: Enumerator testing the WQT kit

WQT. This field note focuses on WQT, the WSP experience in Afghanistan is documented in a separate field note.

To monitor and measure water quality, the WHO/UNICEF JMP and the UNICEF Multiple Indicator Cluster Surveys (MICS) team have developed a water quality survey module for the direct testing of drinking water in household surveys. The focus of this water quality testing is on the presence (or absence) of the bacteria *Escherichia coli (E. coli)*, which is indicative of the level of faecal contamination of the drinking water, when these levels are high, the risk of waterborne gastroenteritis will also increase in those consuming this water. The data collected from this testing will provide critical information to measure progress made on the Sustainable Development Goal (SDG) 6.1: *To achieve universal and equitable access to safe and affordable drinking water by 2030.* Since 2013, this model has been introduced and tested in over 10 countries and each time small improvements have been made to the module and the water testing equipment.

In Afghanistan, the UNICEF WASH section agreed with the Central Statistics Organisation (CSO) of Afghanistan to integrate the module in the ongoing Afghanistan Living Conditions Survey (ALCS) funded by the European Union. The module tested in Afghanistan was the first to use CompactDry plates that only show *E. coli* and no other coliforms, making it easier for enumerators to interpret results reliably. Also, the prototype filtration unit, designed and developed by UNICEF, is much more economical at <10% of the cost of the original WQT equipment. The aim of this pilot was to familiarise the CSO with the water quality survey module, to obtain water quality data from Afghan households, and to test the newly-developed prototype field-based *E. coli* test kit. The module was tested in 10 of the 34 provinces and 11 survey teams were selected to include the water quality module along with their routine survey activities.

KEY POINTS

- Access to 'an improved water source' does not necessarily equate with access to safe water.
- The prototype water testing module piloted in Afghanistan is substantially cheaper than the original design, this may prove to be critical in the GoA's decision to roll-out the testing module at national scale.
- The value of this testing kit is that the low-cost prototype performed well and was easy to use by the enumerators trained in the WQT; making Water QualityTtesting more accesible both in terms of financing and implementation.

This Field Note describes the experience of the implementation of this WQT module. The results of this pilot will be presented, but also, the experiences of the enumerators with the use of this WQT prototype which were collected during feedback sessions with the survey teams.

Description of Intervention: Water quality training and testing

The WQT module was included in the last five months of the ALCS survey (Nov 2016-March 2017). Ten out of 34 provinces were selected

Outcomes: Survey Findings

to test the module and a 3-day training of the enumerators (33 in total, 1 supervisor and 2 enumerators per team, all male) was carried out. After an introductory presentation on water quality and its impact on health, the SDGs and the importance of the MICS in contributing to national monitoring systems that track global development goals and targets, the participants were given an overview of the water quality manual as well as a presentation of the all the elements in the WQT kit. The trainees received a step by step demonstration on how to use the testing kit and how to conduct the water quality tests; emphasising hygienic precautions to be taken in water collection and incubation. Most of the focus during these three days was given to the hands-on practice of using the WQT kits by the participants, first in the training venue, followed by testing the WQT within the CSO compound. Unfortunately, it was not possible at the time of the training to practice the WQT in the field due to security issues, however each participant did get the opportunity to test the WQT kit at least 10-15 times, in teams as well as each enumerator individually. The teams also practiced the interpretation and recording of the results of the WQT and the safe disposal of the used plates. Finally, the teams were given a thorough training in the administering and recording of the WQT questionnaire. At the end of these 3 days of training the participants were found to be confident enough to use the water testing tools and carry out the WQT in the provinces.

During the 5-month survey period, nearly 2,000 water samples were tested for *E. coli* at the source and at the dwellings for 900 households in 10 provinces. It was important to assess the water quality at the water source to understand to what extent *E. coli* contamination takes place right at the source level, and to what extent contamination increases (or not) during the transportation phase and during storage. This allowed the research team to get a clear picture on water safety management issues in these provinces.

The findings of this pilot were twofold, in the first section: ***Water quality results,*** the quantitative results of the WQT's carried out will be presented, mainly the *E. coli* risk levels found in the water samples both at source and household level, per water source type and regional disparities. The second section, ***Feedback from the teams and communities,*** will focus on the experience of the enumerators in using the WQT module; as the main objective of this pilot was for the CSO to gain experience with the WQT module and consequently make an informed decision as to whether the WQT module should be introduced into future household surveys. Hence, this section will detail the experience of the CSO field teams on:

- The usability of the WQT module,
- The interaction of the enumerators with the households,
- The acceptance of the communities of the WQT and,
- Any other lessons that the enumerators shared during the feedback session

WATER QUALITY RESULTS

The 2000 water samples taken from the sources and homes of the participating communities in the MICS were tested on the basis of their *E. coli* risk levels, these were then analysed according to the number of colony forming units (CFU) per 100 millilitres. The key in Box 1 indicates the different risk levels.

The results outlined in Figures 1 and 2 show us that 64% of water samples taken directly at the water sources were contaminated with *E. coli* (34% of those falling into the high/very high risk categories). Furthermore, 80% of the water samples tested at the household level were contaminated with *E. coli* with more than half of those (47%) falling into the very high risk/high risk category.

Box 1: Risk Levels of E. coli
Very High Risk (>100 CFU per 100 mL)
High Risk (11-100 CFU per 100 mL)
Medium Risk (1-10 CFU per 100 mL)
Low Risk (<1 CFU per 100 mL)

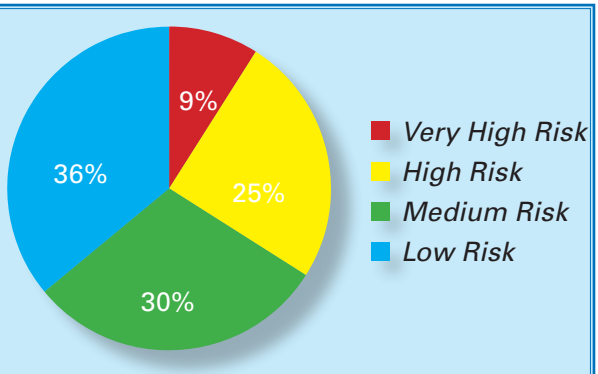


Figure 1: E. coli contamination at the water source

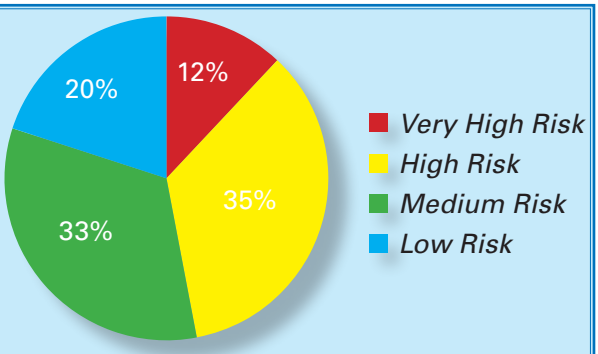


Figure 2: E. coli water contamintation at the Household level

Analysis of the contamination as per water supply service revealed that water taken from unprotected wells and springs were nearly 6 times more likely to be contaminated at a very high or high risk level compared to water from piped water supply (see Figure 3).

Another important result was the difference in water quality between the urban and rural areas. It stands to reason that urban populations benefitted more from piped water supply systems

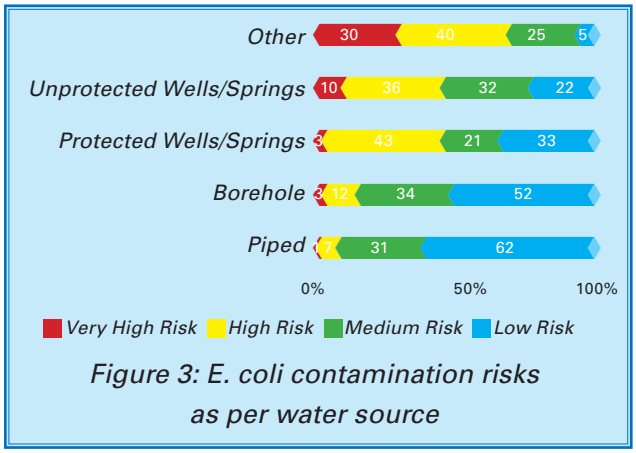


Figure 3: E. coli contamination risks as per water source

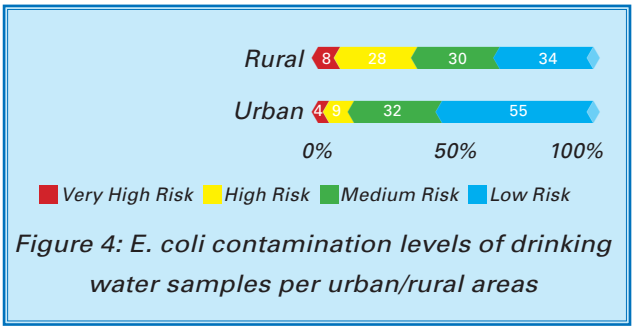


Figure 4: E. coli contamination levels of drinking water samples per urban/rural areas

and boreholes, which in turn are less likely to be contaminated. Hence, in rural areas where unprotected and protected wells and springs are more commonly found, the risks of *E. coli* contamination are higher, as can be observed in Figure 4. What is notable is the difference between rural and urban water contamination by *E. coli.* Overall, communities in the rural areas are almost 3 times more likely to have their water fall into the very high/high risk category compared to urban areas. Finally, substantial regional disparities were found in the quality of drinking water and levels of *E. coli* detected (Figure 5). With two regions; Samangan and Balkh, revealing some very serious contamination issues.

Feedback from the teams and communities

Following the implementation of the Multiple Indicator Cluster Survey (MICS) water quality module, the field teams were called back to Kabul to share their experiences. The feedback sessions focused on assessing the need for adjustments in the water testing equipment and/or protocol, the training they received, as well as receiving a first-hand account of their experience of implementing this new module in the communities and the response they got from the households. The feedback sessions were carried out individually with each team (each team was comprised of 2 enumerators) using an interview guide that had been drafted collaboratively between UNICEF/ JMP/MICS and the CSO staff.

At the end of each interview, each team was asked to share their perspectives and views about the integration of the water quality module under the ALCS.

Feedback on the ease of use of the water quality testing kit and protocols

This pilot implemented three main improvements on the standard water quality testing kits used in previous MICS surveys (Figure 6): (i) Prototype low-cost manifold, (ii) phase change incubator and (iii) *E. coli* only CompactDry plates. An important outcome of the pilot is the feedback from field teams on the use of these innovative products.

Prototype low-cost manifold: Overall, feedback on the low-cost manifold was positive and the quality control results confirmed that this was a suitable alternative to the Millipore manifold used in other surveys.

Phase change incubator: To provide the right conditions for *E. coli* to grow into countable colonies, the CompactDry plates must be kept at approximately 37 degrees Celsius for 24 hours. To maintain this incubation period several options are possible such as battery-operated incubators, however these are often expensive. The low-cost option used in the Afghanistan water quality pilot was a phase change incubator which only requires the heating of a chemical compound for the incubator to remain at the adequate temperature. This method was used in the survey. The enumerators just needed access to boiled water to get the incubator up to the right temperature. Boiled water was easy to obtain for charging the incubator as well as for the blank testing, however it was noted that the incubator was very heavy and hard to handle and that the clip top was difficult to use (as seen in picture 1) and a screw top would be easier as has been suggested above.

New CompactDry plates: The standard CompactDry plates include two enzyme substrates which enable the detection of *E. coli* (blue) and total coliform (pink). The customised "*E. coli* only" CompactDry plates meant that teams could more easily read the results following incubation as the blue colonies would not be masked by the often-greater number of pink other coliform colonies. This also allowed for a simplification of the protocol and a reduction in cost as one rather than two CompactDry plates were needed. In prior surveys integrating

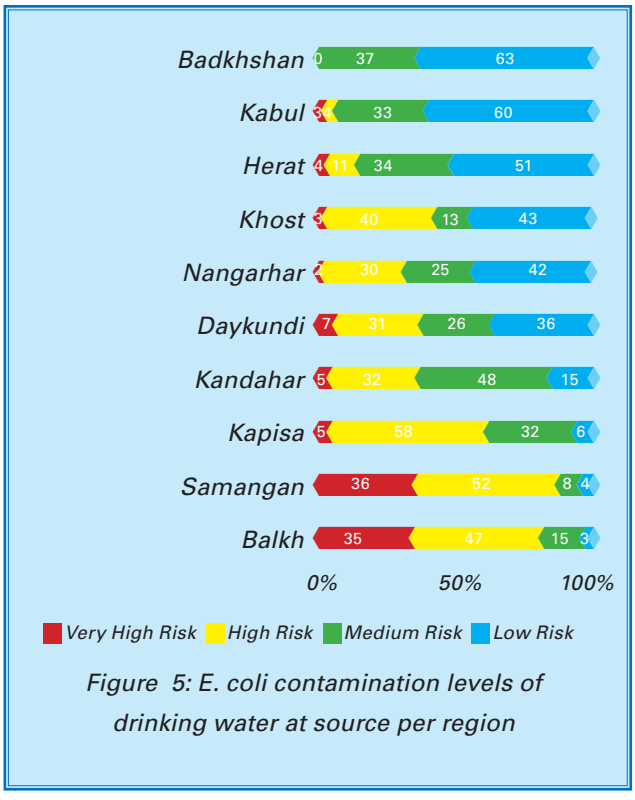
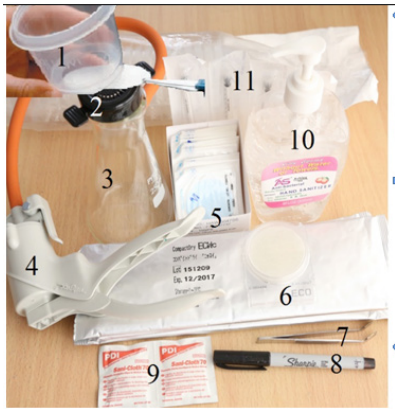


Figure 5: E. coli contamination levels of drinking water at source per region



1. Millipore Microfil Funnel 100ml
2. Filter support part
3. Filtration flask 250ml
4. Vacuum suction pump
5. Filter membrane 0.45µm
6. Compact Dry ECO plates *(E. coli)*
7. Forceps (tweezers)
8. Marker pen
9. Alcohol wipe
10. Hand sanitizer gel
11. Disposable syringe 1ml
12. Phase change incubator

Figure 6: Water quality testing kit used in Afghanistan pilot

water quality testing, surveys a second plate with 1ml of sample has been used to ensure *E. coli* can be quantified when other coliform are too numerous to count on the 100 ml sample. Reading and recording results was carried out after 24-30 hours of processing the water sample and was carried out without any difficulties. The disposable consumables for the water test including the testing plates were occasionally reported to be disposed of inappropriately and only one team used the chlorine provided to the teams to disinfect the plates.

The duration to carry out the WQT's gradually decreased as enumerators got comfortable with the process and the use of the equipment. Initially the test took between 20-30 minutes but after some time this was reduced to 10-15 minutes per test. The entire process: water testing at both source and household took about 40 minutes. All the teams felt that there was not enough time for testing allowed in the survey protocol and that they needed more time to carry out the WQTs satisfactorily.

Additional feedback on the water testing equipment which should be taken into account for future surveys included:

- The carrying bag for the equipment was deemed too small, also it being a shoulder bag was seen to be inconvenient, a backpack was suggested.
- The forceps provided were a little sharp and damaged the filters, flat-tip forceps would be more appropriate.
- Better quality marker pens were requested as those they were given were drying out too quickly.
- The incubator could benefit from a new type of cap (screw rather than the clip currently used as seen in figure 6) for easy handling.
- Processing the water sample without dust contamination was often complicated, on the last day of training an artificial leathercloth (rexine) sheet was provided to carry out the tests

Interaction of the enumerators with the household during and after the water testing

The water sampling and testing process was carried out both inside and outside of the house, this depended on the region and on the acceptance of having unknown men entering the household. Unknown men are often hosted in a guesthouse which is separate from the main house, this made the testing of the water at the household level more complicated as the water was taken at the home to be brought to the guesthouse, there was also the risk of contamination during this transiting of the water.

Carrying out the water testing in the different households was seen to be very straightforward by all the enumerators, in fact households welcomed water testing and it was considered an incentive to participate in the water testing. The 2 times when water testing was not completed were due to a power outage and a non-functioning pump. It was suggested that water of another household could be tested if the selected household was not able to participate due to a technical problem with the water service, this would enable them to continue water testing in the selected community as planned.

Households were very curious as to the purpose and results of the water testing, most people asked when they could expect the results and requested advice if their water was seen to be unsafe. Other questions asked concerned the reasons for the water testing, the potential benefit for the households, what the results will be used for, whether the enumerators came to provide them with new water services, and what *E. coli* was? Enumerators responded to these questions as best as possible; explaining the learning purpose of the water testing, that the test did not mean they were getting a new water service but that the information obtained from this survey will help MRRD to rehabilitate or renew water supply services in the future.

Regarding WQT results, when these were bad, the enumerators provided suggestions as to how they could improve the quality such as chlorination or boiling of the water, but mainly they referred back to the leaflet provided to the households concerning water safety and protection.

Regarding the raising of expectations on potential new investments in water supply services due to the WQT; the enumerators knew how to adequately field these questions ensuring the communities understood that they would not be receiving any new services regardless of the survey outcomes.

Managing expectations was more important in the rural areas where many people in the same community asked for their water to be tested. Two teams pre-empted this situation by requesting the community leader or religious leader to support them in informing the community on the purpose of the water testing and that not all households would have their water tested. This was very effective as when informed the community members did not request for further water testing unlike the communities where enumerators did not relay the information to the local leaders.
A point of interest was that the urban households who participated in the WQTs were not particularly interested in knowing their results, as they said that *'the government only does surveys and there are never any actions taken'.*

However, in the rural areas, all the households called back the enumerators to get their water quality results. When the results were bad, the enumerators felt the households took this very seriously and many asked for chlorine tablets. This was not in the scope of the enumerator's role, however all enumerators requested that the provision of chlorine tablets was considered as according to them; 'it is not appropriate to tell someone in a remote village that their water is unsafe to drink without providing them with any solution'.

The leaflets provided to the communities on the WQT's were much appreciated by the enumerators and the household members alike. The communities requested for the leaflet to include more explanations, more locally recognisable photos, simple water treatment options and water protection advise and the provision of a couple of water chlorine tablets with the leaflet. Enumerators also requested to be trained in safe water chain management so that they could advise the communities when needed.

Overall reflections from enumerators on the WQT Pilot

More than half of the enumerators (a majority of whom implemented the survey in rural areas) considered the integration of the water quality module in the ALCS very useful and supportive of the survey process. The enumerators working in the urban areas were confronted with indifference from a high number of households, hence these teams were less convinced of the necessity to integrate the water quality module in the ALCS.
Forty percent of the enumerators suggested that female enumerators should be trained in the water quality module, as they have easier access to the homes of the households selected for water testing. 40% of the enumerators also mentioned that it would be beneficial to provide all tested households with chlorine tablets as to thank the household for their participation. 80% of the enumerators suggested to enhance the information leaflet by focusing on safe water chain and/or household level water treatment. All enumerators said that the leaflet had been essential in facilitating the first contact with the local leaders and the households. Many of the local leaders told the enumerators they would like the leaflet to be turned into posters to hang on the walls in the community to remind people about water protection and treatment.
All the teams felt that they needed more time to adequately implement the water quality module. The water testing itself was not really time consuming, but the discussion and requests for information from community members where the water testing took place did require more time.

Lessons Learned

Specific lessons learnt from the WQT module implementation are as follows:

- Overall the WQT kit was well designed and provided the enumerators with the appropriate tools to carry out the testing. Some small suggestions for improvements were made such as a more user friendly bag, better forceps and a screw cap instead of a clip cap on the incubator.
- The enumerators should be reminded to safely dispose of the testing plates, this should be a message clearly promoted in the training
- The time needed to adequately carry out the WQT in the field will need to be re-assessed as many of the enumerators mentioned that not enough time had been allowed to carry out the survey protocol. This timing issue will need to be considered if the CSO decides to use the WQT module in their future surveys.

- It was unanimously suggested by the enumerators that in the future one female enumerator should be trained on the water quality module. In fact, on two occasions it was the trained male enumerator's wife who conducted the water test, as it was more acceptable for her to go into the household rather than a man.
- Enumerators should be given further guidance and training on how to respond to frequently asked questions, and how to manage the expectations of the community members whose water will not be tested.
- For future surveys, the CSO may want to consider providing improved information leaflets detailing low-cost water treatment options as well as providing some chlorine tablets. Training the enumerators on water safety advise and low-cost treatment options should be considered as many household members requested this type of advice.

The WQT pilot's overall lessons were the following:

- The urgent need for increased monitoring, protection and treatment of water sources. Two thirds (64%) of the water samples taken at the source level were contaminated with *E. coli*, and nine out of ten (88%) water samples at the household level were contaminated, most likely due to unhygienic transportation and storage methods.
- The high levels of contamination at source level is particularly worrisome, it seems to indicate that water sources are not properly protected from contamination. This can be explained when water is from unprotected wells and springs (46% of samples were very highly/highly contaminated), but from the results in Figure 3, we observe that protected wells and springs are just as likely to be highly or very highly contaminated (46%). These results seem to indicate that there is a real need to revise what a 'protected water source' means and to make more holistic assessments considering a wider range of sanitary risk factors.
- The rolling-out of WSP's will support the process of improving water quality at the source level along with punctual WQTs.
- Regional disparities in water quality are equally concerning when some regions like Samangan and Balkh have both more than 80% of their tested water samples fall into the very high/high contamination levels. It

Picture 2: Leaflet distributed to households selected for water quality testing.

seems that with the ongoing conflict and security issues as well as a longstanding drought, certain provinces will be hard hit in terms of effective and adequate water supply for their populations. The Ministry of Rural Rehabilitation and Development (MRRD) will be able to use the information provided to target those provinces most in need.

- Regarding the experience of the enumerators in implementing the WQT module in the ALCS, this was overwhelmingly positive. The enumerators not only found the WQT module easy and interesting to implement, it was the feedback from the community members, in particular in the rural areas, which made this pilot both worthwhile and gratifying.
- Thanks to the WQT, the enumerators reported having gained increased access to the communities and their homes. The genuine interest of the community members to both know the risk status of their water as well as understand how to improve their water quality was significant.
- One of the main lessons that the enumerators repeated on several occasions was the need to train female enumerators in the WQT module so that they can administer the test within the household where foreign men are usually not allowed. Although UNICEF had initially requested for female enumerators to be trained in WQTs, this was not seen as viable by the CSO; the cultural context in some regions will make it difficult for women to work in certain communities. However, this was not the case in all regions and the participation of women trained by their husbands in the WQT made the process easier and more acceptable as most of the family members in the home are women. A team made up of both a female and male enumerator should be considered for any upcoming WQT.
- Finally, it is noteworthy that the collaboration of CSO and MRRD was a success; for the training and supervision of the field teams as well as the good results from the quality control measures.

Next Steps

The CSO officially requested the support from UNICEF to integrate the WQT module in the ALCS for 2018 in the 34 provinces. Unfortunately, due to both logistical issues and funding constraints this was not launched as planned. The ALCS will now be rolled-out in three separate surveys under the umbrella of the New Afghanistan Development Conditions Survey (ADCS), however the survey containing the WQT remains unfunded at present. The CSO is actively looking for donors who may be interested in funding this survey as to continue implementing the WQT in Afghanistan.

Further follow-up and support actions that may be considered are listed below:

- Currently 33 enumerators in Afghanistan are trained in the use of the WQT module. These skills should be harnessed and the enumerators need to be invited to share their experience at regional and country level to promote the introduction of a WQT module in surveys.
- The survey water quality results from the 10 provinces in Afghanistan needs to be widely shared to underline the risks that households are facing today, even households that get their water from protected boreholes and springs are not safe, as the E coli risks remains high. This information needs to be circulated to create a demand for WQT.
- As Water Safety Plans (WSP) are currently being considered by the MRRD for introduction in rural water and sanitation programs, the WQT module could provide the government with a useful and affordable tool to create a baseline on water quality and in particular the *E. coli* risk. The WSP would then be able to provide an adequate response in how to mitigate the risk.

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