Lessons learned and recommendations based on pilot research in Jordan, Ghana and Senegal 2006-2010

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In November 2006, the World Health Organization (WHO), the Food and Agriculture Organization of the United Nations (FAO) and the International Development Research Centre (IDRC) joined forces in a research initiative entitled *non-treatment options for safe wastewater use in agriculture by low-income urban communities*. The initiative aimed to evaluate the applicability of the third edition of the WHO Guidelines for the Safe Use of Wastewater, Excreta and Greywater in Agriculture and Aquaculture. Through the use of specific case studies, this initiative evaluated the feasibility of the methods and procedures proposed in the guidelines. In addition, the project explored the constraints and obstacles that may be encountered in their implementation.

The flexible and contextualized nature of these new guidelines represents a significant shift in approach. Where previously measurements of health risk would be done by a single regulator, the new guidelines require the involvement of a number of stakeholders in determining both risk, and risk mitigation strategies. This new approach articulated in the guidelines should ensure meaningful use in a range of settings and at different scales, but it also implies involvement of professionals and authorities across several public sectors.

The expected deliverable at the point of departure of this project was a guidance document to assist national and municipal authorities and other users of the guidelines in their application. After four years of work, research teams have provided valuable feedback on the practicality of the WHO Guidelines.

The four case study projects are:
- Ghana/Kumasi: Evaluation of non-treatment options for maximizing public health benefits of WHO guidelines governing the use of wastewater in urban vegetable production in Ghana.
- Ghana/Tamale: Minimizing health risks from using excreta and grey water by poor urban and peri-urban farmers in the Tamale municipality, Ghana.

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- Jordan: Safe use of greywater for agriculture in Jerash Refugee Camp: focus on technical, institutional and managerial aspects of non-treatment options.
- Senegal: Proposition d'étude en vue de l'intégration et de l'application des normes de la réutilization des eaux usées et excréta dans l'agriculture (*Research project on the integration and application of standards in the use of wastewater and excreta in agriculture*).

Over the four years, field teams reviewed different methods of conducting risk assessment, risk management and the enabling environment to assess the feasibility of applying the guidelines; some policy environments favour a comprehensive wastewater related health policy more than others. The following issues were discussed in a final workshop in Amman, Jordan (7-10 March 2010):

RISK ASSESSMENT   Setting health-based targets
                                       Quantitative Microbial Rick Analysis (QMRA) and other
                                       risk assessment approaches
                                       Synthesis of risk assessment

RISK MANAGEMENT   Design of non-treatment options
                                       Effectiveness of non-treatment options
                                       Calculation of cumulative risk reduction
                                       Social acceptability and economic feasibility
                                       Criteria for selection of interventions

ENABLING ENVIRONMENT   Policy framework and regulation
                                       Conditions favouring community participation
                                       Institutional arrangements

The outcome of these discussions is presented below in the form of lessons learned. The technical terminology used is explained in the guidelines and in documents contained in this and the 1st edition of the information kit.

RISK ASSESSMENT

1. Setting Health-based Targets

This was identified early on as a potentially difficult task. None of the projects fully accomplished setting health-based targets. In all projects, however, proxies were used (e.g. indicator bacteria or disease incidence) with the objective to achieve maximum risk reduction. The fact that this was a difficult task for local researchers to complete suggests an important need to emphasize capacity building in the setting and monitoring of health-based targets. One practical option might be to set the most conservative target (e.g. a reduction of 6 logs of *e-coli*) and then aim for the best possible outcome.

Lessons Learned
No team had the core experience required to set health-based targets effectively which is a reflection of the need to build capacity to actually formulate health-based targets. Despite working in wastewater, many of the teams noted that the concept of health-based targets was new to them. A significant amount of backstopping – likely from highly resourced research institutions – would be needed to develop health-based targets unless proxies can be used as is the case with the WHO Drinking Water Guidelines.

2. QMRA and other risk assessment approaches

The research teams learned about the importance of defining systems in terms of where the problem starts, what the exposure routes are, the elements along this food chain and the boundaries of the system, and critical hazard points. Risk assessment of this kind can be challenging as it requires a deep understanding of contextual factors as well as of the variables that can influence health risks. For instance, in the case of diarrhea, the risk can come from contaminated water, food, the market etc. It is equally important to categorize types of people along the chain of risks – e.g. children (coming from schools, playing), farmers, consumers, marketers. A critical step, in order to understand the health risks faced by a population, is to ask the following five questions:

♦ Who is exposed?
♦ Where are they exposed?
♦ When are they exposed?
♦ How are they exposed?
♦ How often are they exposed?

The system of food production through to consumption is defined by *exposure points* – and these, in turn, is largely defined by activities of the target groups. Four different approaches of risk assessment and analysis were used:
1. Epidemiological (stool samples – applied in Tamale, Dakar).
2. QMRA (Tamale, Kumasi).
3. Recall period survey fed into EpiInfo software to correct for confounding factors (Jordan).
4. Multiple regression analysis (Tamale) which was applied to identify the share of diarrhoea cases attributable to bad hygiene and to determine what was the contribution of wastewater to latent health risks.

In the Jordanian case study, data was collected through straightforward household surveys, supported by EpiInfo software. The frequency and incidence of sickness was recorded that aided greatly in identifying hazards. It was found also that identifying hazards for farmers and their immediate households was much easier than identifying wastewater related hazards for consumers and the wider community. For example in Ghana, children playing in gutters, people swimming at a beach or family members of farmers are more difficult subjects to study as the origin of diseases can come from many different exposure points.

Lesson learned
A clear lesson from these projects suggests that the Guidelines over-emphasize QMRA while there are many other (also statistical) mainstream options available to researchers. The challenges imposed by QMRA are amplified by language limitations (i.e. most QMRA material is in English limiting its applicability in some contexts). The possibility of proxies as health indicators should not be discarded; hazard identification should be the first step to be linked to disease incidence as a proxy. To do this properly, a multidisciplinary team is required (including but not necessarily limited to microbiologists, economists, statisticians). Scoping, i.e. setting systems boundaries, for the research exercise is important to ensure that the planned risk assessment is feasible and can be pursued.

3. Synthesis of risk assessment

While each team conducted risk in a slightly different manner, each addressed two common questions: Who is most affected and to what degree are they affected? Each team assessed risk in a slightly different manner. The Kumasi proposal targeted consumers and the team therefore followed the contamination pathway that they established through a preparatory phase of interviews, combined with baseline data collection along the farm-to-fork food chain from previous research. The team then estimated the number of consumers affected. The Tamale proposal targeted farmers exposed to wastewater and the application of raw fecal sludge in agriculture.

In Dakar, because considerable work has already been conducted on wastewater use this project focused instead on and the project focussed on reducing occupational hazards as well as crop contamination. Women sellers and consumers were included in the exposed groups. The Jordan team initially looked at farmers, but after the risk assessment, identified children as a priority group at risk which has important implications for their research.

Lessons learned

It became evident that one must consider the entire system rather than targeting only one group (i.e. household, links between farmers, their families, how food is prepared, hygiene practices; the market). Systems are inherently more complex since many variables can affect risk – and this raises the question why one would not just assume maximum risk, thereby reducing the high costs associated with a full epidemiological study which is outside of the scope of capacity for many research institutions. An important conclusion is that given the high cost to eliminate risk entirely, the more accurate a risk assessment, the more likely one can identify a cost effective solutions. For example, in Jordan, knowing that children playing in street drainage systems is a source of risk would naturally lead to ways of reducing contact between children and wastewater. A compromise could be the use of rapid risk assessments advocated by some epidemiologists.

RISK MANAGEMENT

4. Design of non-treatment options

Non-treatment options are advocated in situations where wastewater treatment is not feasible or readily available. It was clear that all options for preventive measures related to critical hazard points must be identified and defined. For example, one frequently proposed approach of ceasing irrigation two to four days prior to harvest (in order to allow pathogens to die) also can imply unacceptable yield losses of around 10% or more. Such losses were observed in Ghana, rendering the method unfeasible as farmers would not accept the loss of income. Therefore, every option proposed requires thoughtful analysis to ensure that there would be no problems or resistance in implementing the solution.

If recommended measures, such as ceasing irrigation prior to harvest, are applied strictly, non-treatment options can be very effective. Monitoring, however, is critical to ensure compliance and effectiveness. For instance, an analysis on how waste is traditionally used is important to better understand the cultural context. In particular, reliance on surveys is not enough; they should be complemented by direct observations and, importantly, that within the boundaries set, appropriate sample sizes and their representativeness should be ensured. It was noted that monitoring capacity is lacking in many countries.

In the four pilot projects, intervention designs focused on different target groups with the following further specifications:
♦ Kumasi – the focus was on traders as this complemented previous work targeting farmers and street-food vendors, and on consumers' willingness to pay for the additional costs incurred by non-treatment options.
♦ Dakar – the focus was on all groups with the potential to participate in risk reduction.
♦ Tamale – farmers were consulted and researched in terms of their interest in and attitudes towards for example drip irrigation as a safer wastewater irrigation method.
♦ Jordan – a main focus was on awareness raising – for example, on changing practice in collecting olives to reduce exposure. Conventional wisdom had it that non-treatment options were not possible in Jordan, but the project tried to break down barriers to change.

Lessons learned

The evidence for non-treatment options is an important basis through which to inform policy, however, policy making is nuanced and involves a great deal more than simply good evidence. Networking of researchers working on wastewater use is an important element in placing the topic on local and regional policy agendas. Tying the theme of safe wastewater use to larger agendas of food security, poverty and environmental management will likely generate more support in the long run. It was noted that targeted observation – for instance, focusing on one group or on a specific irrigation method - helps to increase the likelihood of uptake and clarifies the evidence. Straightforward proposals are received well by decision makers under pressure to come up with easily understood solutions.

Needless to say, the generation of an evidence base on safe wastewater use is a long process in countries challenged by a lack of sanitation. For example, in the Ghana case, it took more than two years to identify people's current practices, modify these practices, study the economic implications for farmers/traders, study perceptions and to test these modified practices and verify that they did reduce risk levels. Lessons from one country could then feasibly be transferred to other countries if the right incentives and contextual similarities exist. To better assess the transfer of lessons, perception studies and deeper social and market analysis will still be required to assess if uptake of the solutions proposed by this research are realistic.

5. Effectiveness

There were two perspectives raised in the research projects related to the question of the effectiveness of risk mitigation activities. First, the effectiveness *per se* in the removal of health risks as measured in terms of proxy indicators and second, the cost-effectiveness of risk reduction measures. For instance, the use of vinegar as a kitchen practice to disinfect lettuces has proved to be effective *(*achieving a *4 lo*g reduction in e-coli), but can become expensive since a large amount is required. Another example is that of more expensive imported drip irrigation kits as compared to those locally produced.

Lessons learned
Economic arguments for the effectiveness of risk reduction strategies are clearly important. For instance, having a measure of the unit price per log reduction in risk is an appropriate cost-effectiveness indicator if different interventions are to be compared. Essentially, the fundamental question to answer in most research on risk reduction in wastewater irrigation is: how much does it cost a farmer or consumer household to reduce the risk?

Disability-adjusted life years (DALY`s) can be used as an indicator, a feasible approach but one that requires QMRA. Moreover, estimating the dollar value of each DALY reduction requires some basic economic analysis which can be an important measure of cost effectiveness.

6. Calculation of cumulative risk reduction

It is important to note that the multiple-barrier approach assumes that risk reduction occurs cumulatively. For instance, strategies can be employed along the food chain of risk from food production, marketing through to consumption. The research in Kumasi, Ghana explored this and focused on a multi-step process that involved: (1) identifying best practices; (2) assessing their effectiveness and then; (3) combining different options to increase log reduction in risk. In addition to the calculation of cumulative risk reduction, there also should be a disaggregation of cumulative risks for each different target groups (farmers, vendors, consumers). While this is a better way to reduce risk, it can only realistically be done under highly controlled conditions unless appropriate adoption incentives can be provided.

Lessons learned
A main lesson learned was that one cannot just add up independently measured log reductions. The pathogens filtered at one barrier might be the same removed at another and pathogenic re-growth can

occur in between barriers. Collecting the relevant information requires a larger effort in terms of combined field trials.

7. Social acceptability and economic issues

Wastewater use in agriculture is still an activity largely done by the poor and marginalized. This is particularly true when untreated wastewater is used. While recognition of wastewater use may result in some helpful policy, it often draws negative attention to farmers. Increased attention on the risks inherent in wastewater use must be accompanied by practical and acceptable solutions on how health risks can be managed.

While economic analysis was not explicitly addressed in this project, it remains an important element in understanding risk mitigation. If there are large economic trade-offs to reduce health risks, or if the trade-offs are not well understood, most people will opt for the more profitable solution. Sometimes this means taking the risk of infection from wastewater or faecal sludge application. The potential for scaling up risk management solutions is an important factor (uptake through social marketing, establishing economic incentives) and also an area for further research. It is clear that the need for better economic data is required in order to raise the prospect of uptake.

Lessons learned
The introduction of interventions of different types should be carried out incrementally, in a step-wise manner; offering whole packages of integrated interventions at once does not work and may be counterproductive.

Economic incentives would be the best way to achieve social uptake, such as increased prices for produce that is certifiably safe. But this requires risk awareness among consumers if they are to be willing to pay such prices. Where this is lacking, social marketing can support uptake of non-treatment options. Also non-monetary incentives are possible. For example given that urban farmers have a high economic return, tenure security would be an important incentive for farmers to stay in farming and adopt safe wastewater use practices.

Education and awareness creation are considered crucial as no one will change his/her behaviour unless the person knows for what reason they need to change it. The WHO guidelines under-emphasize the mechanisms by which to facilitate the adoption of safer practices and needless to say, the adoption rate matters in the overall result in terms of health impact and the cost-effectives of interventions. In each context appropriate incentives need to be identified and tested and this requires time.

8. Criteria for the selection of interventions

The following criteria had been developed and applied in the studies:

- Cost effectiveness and affordability of the interventions.
- Identification of traditional practices and capitalizing on these (Tamale – faecal sludge management).
- Ownership and adoption potential (linked to social marketing).
- Efficacy in terms of reducing health risk, at least the intervention must be an improvement over what is the current risk.

Lessons learned
The most important criterion is adoptability. How to support this criterion for non-treatment options is not clear in the WHO guidelines and should be further developed.

ENABLING ENVIRONMENT

9. Policy Framework and regulation

Many questions of a policy nature arose repeatedly in the implementation of these studies. Among them: Who is responsible for monitoring? Who regulates? From where should standards be referenced? Who is responsible for failures? In Jordan, for example, enforcement of wastewater use legislation is strong. The previous WHO Guidelines (1989, second edition) are still being used by many policy makers, and are considered the "current" version. It is clear that there will need to be a period of transition and the question is how to increase the uptake of the 2006 Guidelines amongst ministries of health. Standards associations are good targets for evidence since they often develop Standards based on the best evidence available. The Wastewater Safety Plan under development by the WHO could become the basis of a framework for monitoring and control.

Lessons learned
It will be difficult to translate the Guidelines into policies and strategies as long as they are hard to explain and implement. Without policy backing, they may not become institutionalized. The logical lesson is therefore: simplify the guidelines to increase their policy acceptance, or better explain them per country group along the sanitation ladder as some countries need to emphasis more non-treatment options while others can rely on treatment. Clearly, countries where the 1989 Guidelines have already been incorporated into legislation and regulation will require some innovative thinking on how to link the previous edition of the Guidelines to the current, 2006 third edition. A small learning module – as short as one or two days - would be extremely helpful. Currently, few training courses exist, despite the fact that there are a number of international institutions that might be well placed to develop training along these lines. Translation of the guidelines into multiple languages would also be helpful.

10. Conditions favouring institutional arrangements and community participation

Too often, regulatory institutions are working at cross-purposes vis a vis wastewater use. Overcoming this sectoral fragmentation is critical. Meaningful community participation to harness the energies available at the community level helps to surpass sectoral boundaries. At a local level the roles of households and individuals become more pronounced in regulating risk and how wastewater is used in agriculture. In the proposed cross-sectoral approach of integrated risk assessment and incremental risk management it became obvious in all four projects that in all settings there were a range of stakeholders (in some projects specifically addressed in stakeholder workshops) and in all settings the community involvement was a key contributing factor to a positive outcome.

Lessons learned
The essential analysis to be done addresses the question: which ministries are in charge? It is critical to minimize jurisdictional overlap in this process – something which is often a major hindrance to implementing new frameworks. Wastewater policy affects mostly Ministries of Health, Water and Agriculture. Multi-ministerial working groups and capacity development are required to bridge these entities. Capacity building needs could be reduced in low-income countries if the guidelines are easier to understand and also if they do not require advanced (QMRA) or expensive (monitoring) analytical capacities. Also in this case the premise applies: the easier the guidelines can be explained and implemented, the higher the chance of uptake and participation. The credibility of the team encouraging adoption of new practices is a key determinant of success. A community-based process building on the PHAST[4] experience should be pursued since it provides one proven approach of participatory decision-making.

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[4] PHAST – Participatory Hygiene and Sanitation Transformation, step-by-step guide published by WHO in 1998, available at www.who.int/water_sanitation_health/hygiene/envsan/phastep

While the four projects were only short-term pilots to test the implementation potential of the 2006 Guidelines, any serious follow-up will require a longer project period to address the identified technical, institutional and capacity building needs.

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More on each of the individual research projects can be acquired by contacting:

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