Greywater Use in the Middle East and North Africa Region

Background Paper for IDRC-CSBE Experts Meeting

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Overview

As freshwater becomes increasingly scarce, it is necessary for policy makers and leaders to shift attention to alternative sources of water, particularly for the rural and peri-urban poor. Faced with the twin problems of water scarcity and limited access to safe alternative sources of water, some countries - and many of their citizens – are turning towards a formal recognition of the role that wastewater use can play in supplementing existing sources of water for irrigation. This, in turn, has implications for food security – particularly in urban areas where domestic wastewater is plentiful.

The dire situation of water scarcity in the MENA region is well known and documented. Although the MENA region has 5% of the world`s population, it contains only 1% of freshwater resources (World Bank, 2003). It is predicted that by 2025, most countries in MENA will be faced with "absolute" water scarcity (Abou Zeid, 2006). By far, the largest net consumption of water is due to irrigated agriculture, up to 89%, with industrial and domestic uses making up the difference. Also well documented is the inadequacy of conventional, centralised water borne sanitation and the high cost of supply driven approaches to water resource development (WHO, 2000). One implication has been the shifting of research attention onto on-site management practices employed by, and for, the poor.

Movement in general support of wastewater use at the international level has also been noticeable. The Gulf Countries, Cyprus and Saudi Arabia have institutionalized initiatives to reclaim wastewater. Amongst middle-income countries in MENA, Jordan and Tunisia both have well-developed wastewater use policies (Bazza, 2003). The Water Supply Sanitation Collaborative Council (WSSCC) has endorsed the Bellagio Principles that propose, amongst other things, that household centred approaches be emphasized in water and sanitation responses. Meanwhile, an experts meeting on Wastewater Use co-convened by IDRC and IWMI in 2002 endorsed the Hyderabad Declaration which acknowledged the importance of wastewater use in improving livelihoods, while calling for the proper treatment to minimize associated health risks (IWMI, 2002).

Wastewater, including black and greywater, is used as a practice that offers access to an unconventional source of water for irrigation and has been proven to lead to greater income generation for the rural poor. Farmers in Pakistan, for example, have demonstrated a willingness to pay more for land with access to wastewater (Ensink, Simmons and van der Hoek, 2004).

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[1] IDRC is a Canadian crown corporation that is a Canadian Crown corporation that works in close collaboration with researchers from the developing world in their search for the means to build healthier, more equitable, and more prosperous societies. The author gratefully acknowledges the review of Dr. Murad Bino, Stephen McIlwaine and Lorra Thompson for this paper.

Wastewater use is also very much a water demand management strategy (WDM). Water demand management put simply, is 'getting the most from the water that we have', and signifies an improvement in the efficiency of water use to accomplish a specific task. (WaDImena[3], 2006). As marginal quality water, using wastewater minimizes the need and demand for the freshwater.

What is greywater?

Greywater refers to the wastewater that comes from kitchens, bathrooms and laundry. While bathroom and laundry water are relatively benign, kitchen water deserves special attention since it is loaded with organic matter from food waste. Greywater is distinct from black water (that comes from the toilet) as there are fewer health and environmental risks associated with its use. It is estimated that 55% - 65% of household water effluent is greywater (Burnat, 2007; Diener and Morel, 2006). Greywater including its separation, containment and use, is a simple, home-based WDM strategy that has benefits at the household level as an alternative water resource to optimize productivity, if used wisely and appropriately.

Greywater may be used in many ways. In many MENA countries, such as Jordan, the rural poor are employing their own strategies to supplement existing water resources. The CSBE (2003) has shown that, regardless of official policy, many rural and peri-urban farmers use greywater without treatment as a supplement source of irrigation. For instance, in Amman, the Jordanian Department of Statistics found that amongst urban farmer 40% use greywater for their gardens (DOS, 2001)[4]. The most common application is for greywater to be applied directly to crops untreated (CSBE, 2003). However, this form of application has significant pitfalls as the untreated greywater can damage both soil and human health. Greywater is high in saline content and suspended solids that can have adverse impacts on soil quality and drainage. Human health risks are present, as research –albeit limited in availability – has shown that pathogens and faecal matter are present in greywater, particularly where babies occupy the household[5]. Furthermore, where sanitation services do not exist, greywater is often mixed with blackwater and disposed of in the street, next to the home or in nearby watercourses.

As awareness of the potential and challenges associated with greywater recovery and use become apparent, more attention is being placed on how treatment and use at the household level can be promoted. Greywater fundamentally preserves the existing freshwater supply, and in that way is a significant WDM strategy. Estimates of the proportion of household wastewater that is greywater usually vary from 65% up to 80% (Burnat, 2007). No matter the amount, its use conserves water supply by negating the need to acquire water from the municipal network, or, in un-served areas, from private vendors.

[3] The Regional Water Demand Initiative for the Middle East and North Africa (WaDImena) is coordinated by IDRC in partnership with CIDA and IFAD. WaDImena promotes effective water governance in the countries of the MENA region through the application and adaptation of Water Demand Management (WDM) strategies (www.idrc.ca/wadimena)

[4] The survey was included as part of a citywide census that included 12000 households.

[5] When babies are washed, faecal matter can be present in the washing water.

Why an experts meeting?

In the past decade, amongst the research related to wastewater use, a number of projects have focused on greywater use. In 1999, a meeting of environmental organisations and researchers in Gaza convened by IDRC identified the topic of greywater recovery as a priority topic on which action and research was needed. Since then, a number of projects have been implemented in Lebanon, Jordan and the Palestinian territories on the topic. These projects (Bilien, Palestine; Al-Amer villages, Jordan; Bekaa Valley, Lebanon and others outside of MENA) have produced different solutions and exposed challenges that are going to be discussed at length during the experts meeting.

In 2006, the WHO came out with its updated their 1989 "Guidelines for the Safe Use of Wastewater and Excreta in Agriculture and Aquaculture" – a publication that has enormous influence amongst health regulators and practitioners. Part of the updates is that the guidelines include greywater as an acknowledged source of water that is distinct from combined wastewater. Also in 2006, Sandec published a review of greywater management (Diener and Morel, 2006) that summarized existing grey-literature on the topic.

With this evident growing interest in the topic, this meeting of practitioners is designed to assess what is currently being done on greywater in the MENA region. Most participants have direct experience in research on greywater, and in particular, how to safely promote its use for supplemental irrigation. A central purpose of this meeting is to **assess current knowledge and develop a better understanding of research gaps in order to achieve better greywater management at the household and multi-household level for MENA countries**. One output will be a jointly prepared **declaration** that serves to provide future projects and events with basic agreed principles which to follow. It is incumbent on researches to provide insight into how greywater can be used successfully and safely for irrigated agriculture.

What has happened to research on greywater?

Scant information exists on the indigenous practise of greywater recovery and use (CSBE, 2003). While research on greywater in some developed countries exists, in particular, Arizona in the USA, Germany, and Japan, there is little information relevant to developing countries, and particularly the MENA region. This limited scientific data and information on greywater is partly the result of a general limitation of resources for knowledge generation in MENA (Oman, 2007). Morel and Diener (2006) provide an overview of science that exists related to greywater, in addition to a review of treatment interventions from across the globe. The report notes that "…greywater has traditionally been given lowest priority in environmental sanitation systems."

There are a number of pilot projects that are finding both problems and solutions associated with community and household level greywater management. Many of these pilot projects that have an applied research component and will be presented here in Aqaba.

Redwood (2004) has catalogued some existing research related to the economic benefit of wastewater use, however, little data exists specifically on greywater. The premise of the economic argument in favour of wastewater use is clear. For example, the cost of secondary-level treatment for domestic wastewater in MENA, an average of $US 0.5/ m3, is much cheaper than the development of new supplies in the region (World Bank, 2000). This is especially so when the costs associated with the future provision of this dwindling resource is considered. Tunisia and Jordan both sell treated wastewater to farmers. Other compelling evidence focuses on costs saved from wastewater use. In Cyprus, a study of greywater use found that there was a 36% reduction in water bills when household greywater was using a simple system (WHO, 1999). A project implement by the Inter-Islamic Network on Water Resources Development and Management (INW) on greywater use in Jordan found that the value of greywater used amounted to 27% of the average water bill (Faruqui and Al-Jayoussi, 2002). These savings reflect the reduced need to purchase water from the municipal network or from private truck vendors – entrepreneurs who often charge exploitive prices. As noted above, the same study found the cost-benefit ratio of using greywater was 1 to 5. More recent research finds a more modest C/B ratio of one to four (Bino et. al, 2007). So, over a three-year period, for every dollar invested, five were gained in return. This figure was based on benefits from reduced water bills and increased urban agriculture yields and costs such as the installation of the systems. Sources of economic data on wastewater in general are becoming more plentiful, but as noted, research remains to be done related to specifically to greywater. Furthermore, there is little data on the very important impact that household, or semi-collective– water management has on local economic situations. For instance, the multiplier effect of constructing household treatment systems, increasing yields of food for the local market etc.

Overview of Research Issues in Greywater

Environmental Impacts

The net benefit of reusing nutrient rich wastewater for application on land crops is positive, especially if the alternative is to dump the waste into rivers, streams and other surface water (WHO, 2006). Little information on the long-term impact of greywater on soil and crops exists which makes this an obvious entry point for new research. Some researchers point out that high salt content and the existence of too many suspended solids have a negative influence on the soil. One glaring gap is the existence of long-term data on the environmental impact of greywater use (Burnat, 2007).

Greywater is less nutrient-rich than toilet wastewater containing excreta, but nevertheless can be a source phosphorous (from laundry water) and nitrogen (from kitchen waste). If redirected to irrigation, these nutrients help plant growth as opposed to if they are disposed in wastewater, they can cause environmental problems such as eutrophication.

Community Participation

Research and development projects have had mixed success in the deployment of greywater treatment technologies. The challenge highlights the important role of Participatory

Technology Development in the identification of solutions. PTD principles revolve around ensuring that an intervention (technological) is designed with the customer at the centre. The main question, as Peter Laban asks in his paper, is "does the technology meet the fundamental needs of the user?".

However, a technology developed in one area may not be right for another region – even one that might be assumed to be close in terms of need. Cultural factors, social morays such as privacy and other contextual factors must be considered if a project is to be sustainable and succeed.

Local Stakeholder Committees (LSC) are a cornerstone of greywater treatment and use projects since they build local ownership and participation in project development and implementation. This, of course, is provided that they can avoid conflict and be appropriately managed[6]. LSC`s provide short-term stakeholder support for projects, while increasing the likelihood of a more successful long-term outcome (Smirat et. al. 2007; Laban, 2007). Above all, there must be a clear demand for a particular technology and that technology must be built and developed in a participatory manner.

Most examples of greywater use take place at the household level, or with multiple households. The wider movement towards household centred environmental sanitation is a departure from conventional models of centralized water and sanitation and has significant implications for community involvement. For example, household centred approaches require strong buy-in from the household members themselves and have to express a strong support for any kind of wastewater disposal system that they, in effect, manage. Secondly, there must be an extremely strong support system to ensure sustainability of the systems in question. It is therefore critical that any project emphasize training and community involvement.

Social and Cultural Acceptability

The use of greywater has also been shown to result in some unfavourable side effects such as odour. Research in Lebanon and Jordan found that one of the biggest concerns of residents using a household greywater treatment system was the unpleasant smell emanating from the system. Although this is an indication that the system is not being maintained well, it still was a significant barrier to uptake. When it comes to treatment technologies, it is crucial that they be either intrinsically useful or have enough external support for maintenance to be wisely used. And, as Smirat et. al. (2007) note in their paper, community buy-in must occur early on and with continuous involvement.

Cultural acceptability is also an important factor related to greywater use. The WHO recognize that while the use of wastewater is culturally acceptable in some places (China, Japan), it is looked upon with disaffection or indifference in others (the Americas, Africa), and has a history of being viewed with hostility in some Muslim regions (Mara and Cairncross, 1989). The notion that wastewater use is contrary to Islamic principles, has, however, been challenged (Faruqui et. al., 2001) by arguing that it is actually a natural extension of water conservation, which is an Islamic principle, as long as it is treated to the

[6] This problem is surprisingly common as local politics and personality differences can play out in small-scale water and sanitation projects.

extent necessary to protect public health. This is especially true in regions such as Saudi Arabia and Tunisia, both countries characterized as very arid, where national wastewater use is endorsed with the backing of Muslim clerics.

The entrepreneurial spirit of the user, need, interest and motivation to farm, and other social practices also largely influences the practice of greywater use. For instance, in Lebanon, a project of MECAT[7] noted that interest in greywater use varied considerable among different religious communities: Catholic, Druze and Sunni Muslims being more accepting of the practice versus the Shi'a community.

Health

It is inaccurate to believe that greywater has no negative health implications due simply to fact that it does not come into contact with feces. Although greywater might be *less* dangerous than combined domestic wastewater, a number of factors suggest caution where greywater is being used. These include how concentrated the greywater effluent is, the irrigation system used, the types of crops being irrigated, how produce is being consumed and if the source of the greywater includes much kitchen waste. Moreover, cross contamination with faecal matter is a concern.

Pathogenic risks have been shown to be less present in greywater than combined with domestic wastewater. However, the WHO notes that indicator bacteria (e-coli or FC) can sometimes be high in greywater due to the presence of degradable organic matter and not pathogens. In water scarce countries, less water may be used in the household leading to a higher concentration of greywater – and potential risk in the effluent. As Diener and Morel (2006) points out: "Although treatment plant removal rates of 99% or 99.9% may sound impressive, survival rates nevertheless amount to 1% or 0.1%". Direct contact with greywater is a substantial problem if it is not contained, disposed and used properly. Moreover, breathing in aerosol from greywater can be harmful and if there are pathogens present, can lead to illness.

Treatment is the most obvious intervention to reduce health risk. At a minimum, a successful treatment system should fulfill the following criteria: hygienic safety, minimize impact on the environment, aesthetically acceptable to users and be affordable. If these criteria are not met, there is a high chance of failure. The method of treatment also depends on the context of use, human and financial resources. Mechanical treatment is used in Germany and Canada. Biological systems are being experimented with in Lebanon, Jordan and the West Bank. In poorer rural communities, mere separation at the source into a basic settling container followed by use in irrigation is common (Suleiman, 2007; CSBE, 2004). Where land is plentiful, water saving landscapes and constructed wetlands are another way greywater is used for irrigation. In this case, the GW is treated as it travels through the roots of the plants. Although a number of technologies are being tested and exist, there is a lack of proven technological "choices" for beneficiaries to select from when designing a system.

[7] The Middle East Centre for the Transfer of Appropriate Technology

Treatment, if available, is often not able to achieve accepted standards for health protection. In these cases, farmers need to consider alternative non-treatment management options such as **protective clothing** (boots and gloves)[8].
Alternative irrigation methods such as **drip irrigation** have a cost implication but also reduce the risk of direct contact between the farmer and greywater. Anti-worm medication and chemotherapy could be considered as options in cases where risk is acute and other options are not feasible. Cleaning of crops with light bleaches, boiling and other cooking methods are also ways that harmful pathogens can be killed.

A straightforward greywater management strategy is to **match the quality of the marginal water with its use**. For example, greywater can be used on crops with high salinity tolerance, for crops not eaten raw, or for use on crops that are used for animal fodder. Possibly the most effective way of managing contact with greywater is to simply promote **basic hygiene** messages including hand washing and avoiding direct contact with the greywater.

Whatever the strategies may be, there must be a very clear **monitoring and evaluation framework** in place in order for policy to be successful. It is important that such a framework be flexible enough for indicators to reflect local interests and needs. Engaging communities in monitoring strengthen interest and ownership strengthened ultimately leading to more successful policy outcomes. Greywater, as a sub-type of wastewater, should be managed differently and accounted for differently in national water planning including in water budgets.

Policy Frameworks

The new WHO Guidelines on wastewater were heralded in 2006 with a more specific assessment of greywater compared to the 1989 guidelines. Due to WHO influence, this long awaited sequel represents a significant milestone in the development of national and international policies on greywater. The guidelines are premised on the *Stockholm Framework* – an approach that considers contextual health risks before the development of health based targets (WHO, 2006).

Traditionally, national policies have simply prohibited the use of wastewater. The increasing attention of MENA countries being paid to water conservation, especially in irrigated agriculture, is setting the tone for policy support on the use of marginal quality water. Some countries are ahead of the game, such as Tunisia and Jordan, while others are still in the development phase of their national policies. Some provisions might include:

- Building codes adapted to insist on source separation and modified plumbing, especially where there is no connection to the main sewerage network.
- Health standards that follow the newly developed WHO Guidelines – which include greywater specifically - and emphasize a pragmatic, health centred approach.

[8] In practice, however, this has proven extremely difficult due to the low level of awareness that illnesses are in fact caused by the domestic wastewater used in irrigation.

- National Guidelines that provide a step-by-step approach in developing support and targets related to wastewater use – in short, **a national plan** on how to approach wastewater use. The plan should provide specific references to greywater.
- Basing policy on the Bellagio Principles which call for "informed choice" that provides several options for household/multiple household greywater treatment systems, their costs and benefits, and information on how to access suppliers.

These are only a limited number of items, and the Aqaba meeting aims to expose participants to a variety of national strategies, both Northern and Southern, that will expand this list. The new WHO guidelines are a comprehensive review of what is feasible for policy makers, including "how to" where minimizing health risk is central in policy development. A great deal of innovation in the development of on-site water management systems has been demonstrated, but these systems frequently do not mitigate the potential risks associated with greywater use. And, as demonstrated, gaps in knowledge on economic and social issues as well as sustainable implementation of solutions beg to be answered.

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