

Making clear the reuse risk: approaching wastewater irrigation worldwide

● Earlier this year the World Health Organization released a second information kit that includes information to supplement its 2006 guidelines on the safe use of wastewater, excreta and greywater. With the current guidelines viewed as too complex to use, **BILL McCANN** outlines the challenges of forming guidelines that can reflect the differences in wastewater reuse risks across developed and developing countries and at different levels of sanitation.

Four years after publication of the World Health Organization's (WHO's) 3rd edition of 'Guidelines for the safe use of wastewater, excreta and greywater in agriculture', adoption and use of the content remains patchy and, to a large extent, not well understood.

Growth of the practice and in the number of publications dealing with the associated issues was evident well before 2006 and both trends continue.

Since 2006, WHO has felt it necessary to issue two successive 'Information Kits', the second being launched during Stockholm Water Week this summer. At the same time the World Bank published a research paper on the subject and the International Water Management Institute (IWMI) and International Development Research Centre (IDRC) collaborated in publication of a new book, titled: 'Wastewater irrigation and health (assessing and mitigating risk in low income countries)'*.

In assessing key challenges for the future, this book includes the telling phrase: 'So far, a common reaction of agencies, officials and others charged

with managing wastewater, particularly indirect use, is that the (2006) guidelines are simply too complex to understand and use.'

The continuing interest is well placed and the latest publications timely because use of wastewater in agriculture is increasing at pace, especially in low income communities where the drivers are many – urbanization, the need for food in a period of rising food prices, the need for income, and increasing wastewater flows but decreasing raw water availability.

This means that low income families in urban and peri-urban areas in large parts of the developing world have no alternative but to irrigate small vegetable plots and local community land either directly with untreated or partially treated wastewater or indirectly by abstraction from heavily polluted local streams or rivers.

These practices pose considerable health risks both to crop growers and to eventual consumers of the produce. The WHO guidelines are intended to address and reduce these risks but, in doing so, the 2006 version introduced a number of new concepts and approaches which, while offering improvement, especially for countries

where wastewater treatment coverage is low, have made the recommendations considerably more complex.

Addressing risk through fixed irrigation water thresholds has, for example, been replaced with a more flexible approach, which looks at the affected human and health-based targets, achievable through a variety of interventions. Some prefer the simplicity of the earlier approach – and many more are disconcerted by the added complexities of calculating health-based targets, which – although there are alternatives – is best done by Quantitative Microbial Risk Assessment (QMRA) and expressed as Disability Adjusted Life Years (DALYs). In low-income countries, where most of the microbial risks lie, there is usually limited capacity even to understand what these concepts are all about. In that sense the guidelines are impractical and, when wastewater managers in high-income countries complain of the complexities, the charge in some quarters of an overall bias towards the theoretical can be understood.

Meeting the needs of planned and unplanned use

Without entering into that debate, it can be said that coverage of the global issue in a single guideline is a confounding factor when risks and possible solutions are quite different according to the state of development of the country concerned.

As national wealth increases there is more wastewater treatment, a trend from unplanned to planned use of wastewater in agriculture with improving risk control and, in industrialized countries, the risk emphasis moves from pathogens to chemicals. Currently, and for the foreseeable future, the real emphasis has to be on the overwhelming risks in low-income communities.

The latest information kit is based on a number of guidance notes, one of which bears directly on that sector. Intended for national programme managers and engineers it is titled: 'Options for simple on-farm water treatment in developing countries'. It shows clearly that very worthwhile reductions in pathogens can be achieved with low cost on-farm interventions and, in doing so, makes an important addition to the limited range of low-technology options

Settlement, dilution, aeration and ultraviolet exposure in open channels reduces water pollution. Credit: IWMI.



currently included in the guidelines.

Work in Ghana has shown, for example, that simple settlement in small volume (2 to 10m³) ponds for two days can remove nearly all helminth eggs and achieve a two-log reduction in coliform bacteria.

Other quoted work (by WHO) on simple slow sand filters in drum containers showed a reduction of up to three log units for both helminths and bacteria and, in Ghana again, sand columns of 0.5 to 1 metre depth removed between 71 and 96% of helminths and reduced bacteria by about two logs.

Irrigation infrastructure is also shown to be of value, reducing water pollution almost by default through a range of mechanisms – settlement, dilution, aeration, ultraviolet exposure – active in storage ponds, open channels and weirs. A 40km stretch of the Musi River in India, with 13 weirs, is recorded as reducing *E. coli* by over four log units (from seven log) and helminth eggs from 133/litre to zero.

Further research is needed to see if these last impacts can be achieved in a much shorter distance at similar low cost, but all these outcomes can be valuable complements to other risk reduction measures and important components of the multi-barrier approach that WHO emphasises.

Other guidance notes in this second information kit cover, separately, additional information on setting health-based targets and an update on microbial risk assessment. This latter includes improved values for the maximum tolerable additional burden of disease, a matter that will be discussed in Japan this month prior to release of the note (including release online).

Differences relating to development

Going to the heart of a problem alluded to earlier, a fourth note deals specifically with the application of the guidelines to countries at different levels of economic development, and therefore at different positions on the so-called ‘sanitation ladder’, described as:

- Low-income countries with insufficient wastewater treatment capacity and largely uncontrolled wastewater use
- Middle-income countries trying to move from uncontrolled to controlled wastewater use
- High-income countries where wastewater is treated and wastewater irrigation is a planned process

The note characterizes typical irrigation use practices, regulatory frameworks and health issues in these different development bands, and

Selling locally-grown produce in Accra, Ghana.
Credit, P Amoah, IWMI.



tabulates practical examples of the application process, treatment options for different scales of irrigation type, and characteristics of appropriate health-based targets.

In effect this note could easily be seen as a blueprint for a three-way separation of the guidelines because the tables bring into sharp focus just how different the entire situation is in the three development bands.

This is also the theme of the new World Bank report ‘Improving wastewater use in agriculture – an emerging priority’. It covers similar ground, although sub-dividing the middle-income band into higher and lower levels and allotting numerical income ranges to the bands.

Both documents offer a framework for ‘unbundling’ the guidelines according to national levels of development. Pay Drechsel of IWMI, involved in the authoring of most of the publications mentioned here, is one who believes application would be easier if there was simply one volume for each of the three income bands.

He sees the guidance note ‘Applying the guidelines along the sanitation ladder’ as setting out, in a more practical way, examples of the necessary steps for programme managers and engineers to apply the guidelines.

Health impact in low-income countries

Most attention has to be given to the low-income band and some communities in the less well-served sectors of the middle income band. It is here that the greatest problems lie, broadly where investments in wastewater collection and treatment are continuing to lag behind both the provision of water service and the growth in populations.

Thus more wastewater is generated

and watercourse pollution worsens, generally in urban and peri-urban communities. Currently irrigation with polluted water is said by IWMI to be a fact of life in four out of five cities in the developing world and, viewed globally, the area under polluted water irrigation is estimated as at least ten times the area being irrigated with treated water.

‘Wastewater irrigation and health’ estimates that, besides the increasing area of irrigation with treated wastewater, there are around four million hectares irrigated with heavily polluted water in China, 190,000ha in Mexico, 70,000ha in India and 40,000ha each in Chile and Syria. A significant fact here is that, with the exception of Mexico, the supporting data for these estimates is marked ‘unreliable’.

That is a common characteristic of polluted water irrigation because of the typically informal nature of the practice – but it is just one of several difficulties that, taken together, highlight the very basic needs that mark out this sector so distinctly from the more developed regions.

As the book says: ‘In many developing countries authorities are hardly equipped to address point pollution, and are increasingly lost in view of diffuse hazards. Risk-assessment methods have never been used; data for risk quantification is missing; and there is no local information on the effect of available mitigation measures in terms of safety, risk-reduction potential, and economic and cultural acceptability.’

Pay Drechsel goes further, noting that the mere existence of wastewater treatment plants in low-income countries can give a false impression. ‘Often, if we look at the functionality we can only cry,’ says Drechsel. ‘A recent IWMI survey in Ghana showed that of about 70, mostly decentralized,

wastewater and faecal sludge treatment plants, only about 10% were working as designed, and these were mostly at the larger hotels. And, had all 70 been working properly they would have treated less than 10% of the urban wastewater flows.

'So the phenomenon of unwanted wastewater use is not a temporary problem, which a few infrastructure investments can easily stop, but a very severe one,' he continues. 'Even new plants appear to run on a 'design to failure' trajectory. They suffer from poor maintenance and most depend on an electrical supply. Many companies underestimate the frequency of day-long power cuts, for example, in Africa.

'Key requirements are incentives to ensure better operation and maintenance, more simple but effective decentralized plants and, particularly, plants that do not depend on electricity for operation.'

One other feature deserves remark in the book's tabling of irrigated areas under untreated and treated wastewater. Chile, still with an estimated 40,000ha under polluted water irrigation is also credited, more reliably, with 130,000ha of treated water irrigation.

After correctly identifying polluted water irrigation as the root cause of endemic disease the country has taken decisive action over the last two decades to remedy the situation by improving irrigation water quality, changing farm irrigation practices and household use of raw vegetables. Typhoid incidence declined nationally from 50 cases per 100,000 population in the pre-intervention period up to 1990, to just 2.2 per 100,000 in 2006.

It is a remarkable success story but, as Drechsel cautions, there always remains a risk, one that, in this case, was highlighted by the disastrous earthquake that recently afflicted the country. According to WHO it affected the only chlorine-producing plant in Chile and two weeks later 30,000-40,000 cases of diarrhoea were reported from the north where chlorine is used as a single safeguard in agricultural production systems based on wastewater.

This points to the strengths of the multi-barrier approach to risk reduction that is recommended in the guidelines and applicable at all development levels.

In low-income communities where formal wastewater treatment

provision is not feasible and capacity for regulation and monitoring is limited or non-existent, improvements will best be achieved by encouraging behaviour change at the farm, in the markets and with consumers.

Nor, in these situations, will it easily be possible for those concerned to gauge the effect of a specific intervention on risk reduction. In that case the safe approach will be to take advantage of the range of simple on-farm treatments and non-treatment interventions that can reduce risk, aiming for a combination that will give a five or six log pathogen reduction.

While that might be the ultimate target this is essentially a step-by-step process, depending on what is achievable in any community at a given time.

As Drechsel says, any degree of risk reduction is an advance and, in these least well-served communities the best approach is to encourage behaviour change through social marketing, community mobilization, incentives and education. ●

* Now translated into French. Available free online at: www.iwmi.cgiar.org/Publications/books/pdf/Wastewater_Irrigation_and_Health_book.pdf



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