SANIRESCH

Research Project SanitaryRecycling Eschborn (SANIRESCH)
Project component: International Adaptability

1. Background

The analysis of the international adaptability of the three treatment systems designed for and used within the SANIRESCH project specifically focused on developing countries. The systems are a Magnesium-Ammonium-Phosphate (MAP) precipitation reactor and two membrane bioreactors (MBRs) treating the grey- and brownwater.

The aim was to identify regions and typical situations that are suitable for the implementation of the concept and its technical design. Additionally, adaptations required for running the treatment plants successfully in emerging and developing countries were identified.

2. Material and methods

As method the utility analysis (UA) was chosen amongst a variety of other multi-criteria-decision making tools. The UA is generally used for comparing and prioritising complex projects or technologies according to a pre-defined target system. In the first step relevant criteria are defined, weighted and allocated with a rating factor. The individual scores of the criteria are calculated by multiplying the weighting factor of the individual criteria with the rating factor. The individual scores are then summed up to the total score (see Table 1).

The criteria that were used in this analysis can be classified as main-criteria and sub-criteria. The main-criteria are *health and hygiene, economic, functional and technical, environmental as well as socio-cultural criteria*. They have been derived from a study regarding sustainability aspects of urban wastewater management (Hellström et al. 2000). Based on the main-criteria a series of relevant sub-criteria were defined and weighted during several expert interviews. The objective was to design UA matrices that can be adapted and used widely to assess the successful implementation of new alternative sanitation systems (cf. Table 1).

Also the UA was used to identify hotspots for the three technologies, where they can be implemented in a global context and demand can be expected. The same matrices were used but reduced containing a selective number of criteria assuring the application of straightforward and, on a global level, easily available data.
The criteria used for the hotspot analyses were: *water scarcity, freshwater quality, nutrient- and fertiliser demand / availability, eutrophication, population density and rate of urbanisation.*

3. Results and discussion

The first result was the design of matrices ready to be adapted and used for the assessment of a successful implementation of such a sanitation system. Table 1 presents an excerpt of such a UA matrix. The full matrices can be accessed on the SANRIESCH website in the respective studies available for downloading: www.saniresch.de/en/publications-a-downloads/results.

Table 1: Excerpt from utility analysis matrix as developed within this project.

ID	Criteria	Weighting	Raiting description	Rating	Score
...	...	...	...	...	x
E	Environmental criteria	30 %			166 [Σ=E1+E2+E3]
E1	Water scarcity	12 %	high = 10; medium = 5; low = 1; no = 0	10	120
E2	Freshwater quality	7 %	high = 10; medium = 5; low = 1; no = 0	5	35
E3	...	11%	high = 10; medium = 5; low = 1; no = 0	1	11
...	...				
Total score					x % = (166 + x) /10

Apart from that, 3 hotspot maps showing the respective technologies were produced. As an example Figure 1 shows a illustration of the combined hotspots of all involved technologies.

The analysis for the MAP precipitation technology showed that the highest scores were achieved by countries with large population numbers, a high demand for food and hence intensive agricultural activities such as India or Mexico. Another result was that countries in Africa generally yielded low scores. This can mainly be explained by the high proportion of subsistence farming with low or non existing demand for nutrient inputs in terms of industrial fertilisers.

The grey- and brownwater MBR processes were examined as well. The two MBR systems are apart from small technical differences similar in their design. Hence, the assessment of their international adaptability also revealed similar results. The results for both plant types were mostly affected by the sub-criteria water scarcity and freshwater quality. Countries within the Middle East and North Africa region such as Jordan, Egypt, Libya, Oman or Israel showed the highest scores.

SPONSORED BY THE
Federal Ministry of Education and Research

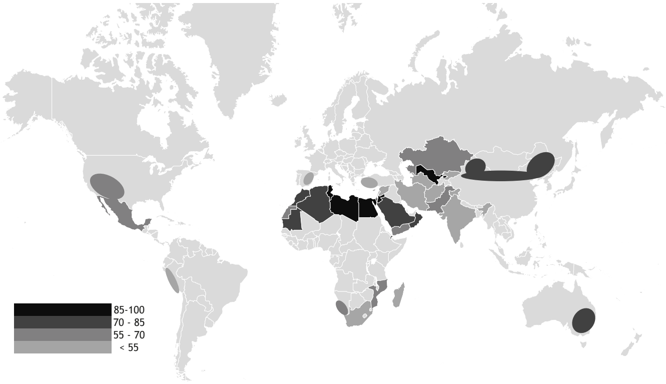

Figure 1: Potential hotspots for the implementation of all three analysed technologies.

Apart from that also countries allocated within Central Asia (e.g. Uzbekistan), parts of South-East Australia, the west coasts of the Americas, India and parts of Southern Africa were identified as hotspots. Due to the potential of reusing nutrients contained in the brownwater, the matrix for that analysis included the criterion nutrient demand. However, it could be proven that this criterion can be neglected when considering the overall assessment.

It could be shown that only nine of the 58 analysed countries can be identified as hotspots for a combination of the three technologies. All of the identified countries are facing water scarcity and have a high nutrient demand due to a large population requiring intensive agriculture. This demand in terms of industrial fertiliser cannot be met by domestic phosphorus resources (see Figure 1). The following group, where two out of three technologies could be identified as appropriate is focused on the MENA region. This combination always consisted of the two MBR systems.

To bridge the gap between the potential demand identified in this project, it is also necessary to consider the prevalent framework conditions. When looking at nutrient recovery (MAP precipitation) the issue of peak phosphorus is crucial. Furthermore, not only fiscal incentives for potential operators, technical aspects such as user-friendly design, permanent power supply and well-trained staff, but also socio-cultural aspects such as sensitisation measures accompanying the implementation process are important to consider.

When focusing more on water treatment and reuse by MBRs, the same fiscal incentives, technical as well as socio-cultural aspects are valid. But unlike the MAP precipitation, in some cases such as in water scarce areas without infrastructure, the MBR systems do provide a strong economic argument.

4. Conclusion and outlook

Overall both, the design of the decision support tool as well as the hotspot analysis reveal a clear picture of the international adaptability of the technologies. Nonetheless, the picture created here does only represent the potential demand side.

In relation with the framework conditions that have been presented, the results become more reliable. However, the actual demand is still subject to further investigations and real life implementation and testing. Finally, it has to be pointed out that aggregated data had been used for the analyses which do not allow detailed regional estimations.

Contemporary trends like climate change involving regional increases of droughts, an exponentially growing population demanding both more water and food and especially relevant for developing countries, the constantly growing trend of urbanisation requiring more space-efficient wastewater treatment technologies articulates the relevance and meaningfulness of this research area.

5. Major references

Hellström, D., Jeppsson, U., Kärrman, E. (2000): A framework for systems analysis of sustainable urban water management. Environmental Impact Assessment Review, 20, 311-321.

Löw, K. (2011): An innovative greywater treatment system for urban areas – International transferability of a German approach, installed in GIZ's headquarters in Eschborn, Master thesis. HfWU - Nürtingen-Geislingen Universität, Nürtingen.

Wu, Y. (2011): Internationale Übertragbarkeit der in der GIZ Zentrale in Eschborn installierten Braunwasserbehandlungsanlage, Master thesis. HfWU - Nürtingen-Geislingen Universität, Nürtingen.

Acknowledgment:

This research was realised within the research project SanitaryRecycling Eschborn (SANIRESCH) and supported by the BMBF (Federal Ministry for Education and Research), fund No. 02WD0947. The authors thank the BMBF for the financial support. We also thank Katharina Löw, Yue Wu, Jingjing Peng and their supervisors for their valuable contributions.

Authors: Enno Schröder, Martina Winker

Responsible partner: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Sustainable sanitation programme
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany

Publisher: Coordination by Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
Dag-Hammarskjöld-Weg 1-5
65760 Eschborn, Germany

I: www.saniresch.de/en
E: saniresch@giz.de

October 2012