Integrated Water Resources Management in the Lower Jordan Rift Valley

Sustainable Management of Available Water Resources with Innovative Technologies

Between Disgust and Trust: State of Social Science Research on the Implementation and Acceptance of Water and Wastewater Reclamation and Re-use (WWT&R)

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Introduction

Drought, water scarcity and pollution are issues of increasing concern in many parts of the world, partly driven by climate change. Global models predict not only the growing need for water resources but also highlight the potential of and the increasing demand for wastewater treatment and re-use (WWT&R) solutions to solve water related problems. Feasibility studies, however, show as a matter of fact: The demand for WWT&R solutions is actually unexpectedly sluggish, and their implementation is remarkably lagging.

This paper reviews current social science research in order to determine factors that enable and constrain the implementation of WWT&R solutions. The paper is based on a conventional literature survey, the preliminary evaluation of surveys of a number of international water re-use projects and the findings of international workshops. The paper aims to reconstruct approaches and empirical results of social science research on WWT&R in order to bring in lessons learnt from past implementation experiences on water re-use into the design of new research projects.

Section I summarizes research results on the state and future trends of WWT&R, outlines major challenges and highlights critical factors that limit their implementation. As many water re-use projects encountered public resistance in Australia and the U.S., public perception and acceptance also became a major topic for social science research. Section II discusses major findings of the first wave of social science research on public acceptance that is based on psychological frameworks and framed around the “yuck factor” explanation. Section III presents results of second wave of social science research that call for more effective stakeholder consultation and public engagement and shift from socio-psychological to political and institutional explanations.

Section IV sums up lessons learnt from social science research on implementation.

I. ADDRESSING THE GAP BETWEEN THEORETICAL NEEDS IN THEORY AND PRACTICAL DEMANDS

The first section summarizes social research findings on the state of and future trends of the WWT&R solutions and outlines major challenges to their effective implementation.

I.1. Predictions of the Growing Need for Water and the Lacking Demand for WWT&R

Different regions all over the world have witnessed growing water stress, both in terms of water scarcity and quality deterioration over the last two decades. Water scarcity and pollution will not "evaporate," but significantly intensify. Global models and regionalized scenarios suggest that the already critical water scarcity will be even more pressing in the near future, especially in semi-arid areas (IPCC 2007). Even if these challenges are partly caused by climatic changes, they will be enforced by human activities such as the unsustainable use, the overuse and the pollution of scarce (groundwater) resources and the degradation of related ecosystems.[1]

Taken together, these trends highlight the need for comprehensive adaptation strategies including innovative technologies. WWT&R solutions (reclaimed water, water re-use, especially decentralized approaches) are discussed as response options with great potential since they open up a broad range of **options for application**: direct applications such as irrigation, indirect potable re-use, groundwater recharge and aquifer storage and recovery (Angelakis and Durham 2008; Bixio et al. 2005; Bixio et al. 2006; Bixio et al. 2008). Water reclamation and re-use solutions are being introduced in a number of countries and are increasingly flagged as a key component of Integrated Water Resource Management (IWRM), and of adaptation to climate change. Several studies conducted by water research groups have pointed to the noticeable benefits of re-use options, suggesting that it can bring cost, water, and energy savings compared with average developments (Stenekes et al. 2006). To meet the growing water need, the emphasis has until now been on demand management rather than water recycling, but much of the "low hanging fruit" has now been picked (Stenekes et al. 2006). Water recycling of any kind can potentially provide greater opportunities for reducing potable water draw-down and municipal effluent volumes than can demand management.

WWT&R solutions in general are seen as part of the answer to sustainable water management as they are location-adapted and tailored to regional needs, and designed for long-term use, including suitable management systems and sets of measures for improving water availability and quality at relatively low costs (Lens et al. 2001). Decentralized water solutions in particular represent a paradigm shift

[1] In the latest reports, released 2007, the IPCC predicts critical water shortages in China and Australia, as well as parts of Europe and the United States (2007). Africa and poor countries such as Bangladesh would be most affected because they are least able to cope with drought. Impacts of climate change and shifts in weather patterns towards extremes will intensify water related problems. Although the availability of water is already limited, the demand for water is still rising, mainly caused by human activities such as population and industrial growth, growing consumer needs, urbanization, diffused pollution, unreliable precipitation, short-term population increases due to tourism and increased demand for irrigation to improve agricultural productivity.

because they rely on principles of integration and prevention rather than of technological intervention and treatment.[2] Conventional approaches to water management are based on the traditional "once-through" paradigm and linear understandings of the flow of water. Decentralized systems, however, resemble the original natural water cycle more closely than the intervention of conventional centralized systems as the water cycle is, to a great, extent localized and "closed loop." Studies suggest decentralized systems could be less resource intensive and more environmentally beneficial than conventional systems, as they are more efficient and reflexive in terms of minimizing and balancing material flux. They may contribute to reduce mains water draw down, materials and energy use, piped infrastructure and at the same time reduce the amount of nutrients entering waterways through re-use (Esrey 2002; Livingston et al. 2004).

Recent scenario and assessments literature and policy documents stress the great potential, the added value and the growing need for WWT&R for solving problems. They suggest that increasing water stress automatically leads to the growing need for WWT&R solutions and temporal or regional water scarcity makes them "necessary" for some regions, thus it is only a matter of time until their demand will rise (Hartley 2006; see also BMU/ UBA 2007).

First assessments of the feasibility, the market potential and studies on the regional distribution and implementation of re-use projects conducted in different regions (mainly the U.S., Australia, and Europe), however, bring far-reaching expectations down to earth. Case studies conducted in different parts of the world come to comparable conclusions:

- Despite its acknowledged potential and evident benefits, water recycling has not been widely put into practice. There are many projects currently proposed, however, existing water re-use projects are the exception rather than the rule.
- Both large and small scale decentralized treatment technologies and distribution systems are in a very early stage of technological invention or of tapping the market. Thus, the technological "pull" is still low and the "push" and the critical mass for these technologies are still missing (BMU/ UBA 2007). In cases where appropriate technologies are available, they are not widely applied and efficiently used (Bixio et al. 2008).
- Even if water re-use is increasingly becoming recognized as a viable water source in national strategies and planning, there is a tremendous lack when it comes to realizing the potential (Angelakis and Durham 2008; BMU/ UBA 2007; Bixio et al. 2006, 2008; Dolničar and Saunders 2006; Salgot 2008; Stenekes et al. 2006). In general, despite the opportunities available there has not been more significant appropriation of the benefits of all types of water recycling (Stenekes et al. 2006). In many European countries where reclaimed water re-use is currently implemented, mainly for irrigation purposes, its potential has not yet been fully exploited (Bixio et al. 2008).

[2] An argument for consideration of decentralized approaches in particular is the heavy financial burden of investment in an aging infrastructure network. Given that much of the existing infrastructure is reaching the end of its serviceable life, the economic cost of continuing such investments need to be considered further, given that other less capital-intensive options are available (Lens et al. 2001; BMU/ UBA 2007; Stenekes et al. 2006).

I.2. Factors Explaining the Lack of Implementation of WWT&R Solutions – The Broader Picture

The gap between the increasing need predicted by models and the missing demand and lack of implementation in practice leave observers with a puzzle. In order to explain this gap, the paper reviews the current social science research on implementation experiences with WWT&R solutions.
In order to understand typical features of social science research on WWT&R, we have to take a look at the context in which it operates. Since its beginning the research landscape is dominated by natural sciences and engineers. The development of and social science research on WWT&R solutions is mainly funded by the water industry and governmental agencies such as the U.S. Environmental Protection Agency (1992). Research and development of projects in this applied context are often characterized by their "engineering project management agency" (Stenekes et al. 2006; Marks 2006). Until now WWT&R research and projects are mainly technology-driven and focus on physical outcomes achieved through novel technology. Researchers highlighted – as expected – the need for innovative technologies, technology transfer, and novel applications. Beside these technological challenges and requirements research also started to outline problems such as the lack of knowledge and difficulties in the assessment of reclaimed real quality in realtime and the implementation of scientific methodologies for the needed epidemiological studies and a never-ending discussion among scientists on the acceptable level of the standards to be applied (Miller 2006). The genesis and the disciplinary organization of WWT&R related research also explain why social scientist play a marginal role and take a back seat by mainly filling knowledge gaps of natural science research and engineering experiments up to the present. In comparison to other fields such as GMO crops, relatively modest social science research has so far been undertaken and empirical results and concepts are not as sophisticated and advanced as in other, well established fields of research.

Against this scientific backdrop the next section will discuss what challenges and critical factors are debated in social science, which influence the implementation of WWT&R solutions.

I.2.1. Risks and Negative Externalities of WWT&R - Impacts on Health and Environment

In the early 1980s it was realized that to an increasing degree the implementation of re-use schemes might lead to non-intended and adverse impacts on human health and the environment. One of the major tasks became the challenge to address side-effects and negative externalities of WWT&R. Approaches to risk assessment and management gained importance (Ganoulis and Papalopoulou 1996; Shuval et al. 1997). The awareness of potential risks broadened the scope of research from single technologies to integrated system solutions. Different water reclamation strategies started to incorporate multiple measures to minimize health and environmental risks associated with various re-use applications. Connected to internalizing environmental concerns, the focus of research shifted from technological options (the use of advanced wastewater treatments including membranes) to environmental impact assessment such as addressing emerging pollutants of concern, and salinity management (including concentrate disposal). This also led to the inclusion of new

approaches. By taking over approaches of risk assessment, the discourse of re-use also changed (Asano and Levine 1996; Shuval et al. 1997). First of all, after decades of development in technology and construction of plants, a growing need for both integrated concepts and inclusion of multiple criteria was recognized (Joksimovic et al. 1996; Joksimovic et al. 2006; Joksimovic et al. 2005; Urkiaga et al. 2008; Balkema et al. 2002). These needs were also taken into account by international research projects such as OZ and EU AQUAREC (Bixio et al. 2008; Dillon 2000; Hochstrat et al. 2008; Koning et al. 2008).[3] Experience with previous technology and management practice suggests that the challenges are not only of a technological nature, but also raise questions regarding proper management, organization and regulation. Thus, research activities expanded from merely technical issues to include broader and economic and political issues.

I.2.2. Lacking Incentives – Water Pricing

First, social scientific assessment defined problems to implement WWT&R as the result of several factors including present cost structures for water and regulatory framework conditions. Explanations mainly relied on missing incentives to buy into re-use solutions. They are guided by the experience that the attractiveness of water solutions depends to a large extent on the assumptions made about which benefits, costs, and risks to the community are considered and how they are valued in economic terms (Salgot 2008).

Reclaimed water is often introduced as an economically viable alternative, since new water sources and old infrastructure are increasingly more expensive to maintain, requiring high capture, conveyance, and pumping costs (BMU/ UBA 2007). In many countries, however, the cost of providing recycled water is not competitive with the low price of mains water, which is a significant disincentive to invest in recycling. The price allowed for mains water is low because the pricing structure does not account for financing subsidies, investment costs as well costs involved to keep the system operating and for externalities, that is, the impacts of water extraction and sewage disposal on the environment. Until now, water-pricing arguments tend to be conducted in terms of the average cost of present provision, rather than the marginal cost of new provision, and do not fully incorporate the cost of expanding present provision to cover the projected increase in demand. Thus, the current prizing does not discourage wastage nor encourage the take-up of water efficient devices and it does not reflect the vulnerability and variability of supply (Stenekes et al. 2006). If the true impact of supplying and then disposing water were taken into consideration, the alternatives may become more feasible and water management could improve.

Interestingly, empirical research does not simply confirm the underlying idea that pricing strategies had direct impacts on the willingness to pay for or to adopt recycled water. Focus groups results as well as survey findings suggest that “cost benefits” are the most important benefit users of recycled water state (Marks 2004; Po and Nancarrow 2004). Surveys of farmers and consumers have found that both attitudinal factors, such as environmental awareness and economic factors, such as freshwater prices and income are significant in explaining the willingness to use (WTU) and willingness to pay (WTP) for recycled water and products produced with it, but that

[3] See EU Aquarec “Integrated Concepts for Re-use of Upgraded Wastewater” (http://www.aquarec.org/) and OzAquarec: “Integrated Concepts for Re-use of Upgraded Wastewater in Australia” (http://www.uow.edu.au/eng/cme/research/ozaquarec/index.html9, see also http://www.emwater.org/).

important differences exist between farmers and consumers (Po et al. 2004). On the opposite end of the spectrum, Alhumoud, Behbehani & Abdullah sum up that Kuwaitis would be willing to pay more for their water in order to avoid having to use recycled water (see Dolničar and Saunders 2006). Other surveys, however, show that increases in prices of conventional water sources did not have any impact on peoples' willingness to use recycled water. This finding is in accordance with results showing low price elasticity for water in general. The interaction of willingness to adopt recycled water and pricing strategies has not led to conclusive results so far and would be of great interest for future research (ibid.).

I.2.3. Need for Stronger Regulations

Beside the need for mechanisms that make use of economic incentives such as prices, most researchers call for stronger, more coherent and comprehensive regulatory approaches and frameworks (Bixio et al. 2006; Brissaud 2008; Salgot 2008). There is a considerable lack of integration and coordination and thus inconsistency in water management across regions, states and across sectors and policies. Several vigorous attempts have been made in different countries and regions, but, unfortunately, uniform guidelines, standards, suitable techniques and criteria are not established by rules and regulations.[4] Though the need for sharing common regulations or, at least, a common rationale for developing water re-use standards has been acknowledged, this objective does not appear to be attainable in the near future. Among the factors that may be evoked for an explanation of the dramatic discrepancies in the criteria, the lack of a clear rationale, based on scientifically established data, is a major hindrance for setting up effective water re-use guidelines.
To sum up: The empirical findings indicate that an increased utilization of reclaimed wastewater, requires dedicated economic instruments, the set-up of standardized water re-use guidelines and planning procedures for establishing reclamation and re-use in specific sites (Bixio et al. 2006; Salgot 2008).

I.2.4. Discovering Public Acceptance as the Main Hurdle

In the 1990s, a number of high profile indirect potable water re-use projects encountered stiff public opposition. In the U.S. and Australia, several high-profile initiatives have been halted after several years of planning and tremendous

[4] Many developing countries have adopted an approach based on the World Health Organization's (WHO) recommendations, which usually translate into lower technology levels and lower costs while addressing the health risk. Most developed countries have established low-risk guidelines or standards based on a high technology/high-cost approach. Even in single countries as the U.S., e.g., there are no federal regulations governing water re-use. Hence, the regulatory burden rests with the individual states. This has resulted in differing standards among states that have developed criteria (Crook and Surampalli 1996; Brissaud 2008). Countries where re-use is developing within an organized institutional setting have elaborated and implemented their own regulations or guidelines. Some countries (France, Tunisia) and regions (Andalusia and Balearic Islands in Spain and Sicily in Italy) have adopted a set of water quality criteria based on the WHO guidelines, while other countries (Cyprus, Italy, Israel) elaborated regulations or guidelines close to the more conservative California's Water Recycling Criteria (Brissaud 2008). In Europe, the full implementation of the Urban Waste Water Treatment Directive (91/271/EEC) will contribute to obtain treated wastewaters of quite high quality that could be re-used for certain applications or improved by polishing steps for uses with higher quality requirements.

expenditures (Hartley 2006). Terms like “Toilet to Tap,” “Sewage Beverage” and “Citizens Against Drinking Sewage” are common in the public dialog. As a result, public perception and acceptance became an issue and were seen as major hurdles to the accomplishment of water re-use projects. Broad concern about community perception of water recycling and frustrations in implementing projects has led to a focus on public acceptance among the water industry. As (non-potable and potable, principally in-direct potable) water re-use initiatives faced increasing public opposition, research centers such as the Commonwealth Scientific and Industrial Research Organization (CSIRO) started funding research on factors that may influence behavioral acceptability of water re-use and may affect public perceptions. Thus, in many interdisciplinary research projects such as OZ and EU AQUAREC, the scope of research has broadened from purely technical questions over the economics of water re-use to issues of public perception (Bixio et al. 2008; Russell and Hampton 2006). In effect, the main questions have been posed in terms of the factors that are responsible for “unfavorable” public attitudes (Dillon 2000).[5]

II. THE “YUCK FACTOR” – (MIS)-UNDERSTANDING PUBLIC PERCEPTION AND ACCEPTANCE

The social science literature on recycled water has centered on socio-psychological studies that are framed around the “yuck” factor explanation and that are based on empirical surveys (for a summary of existing international literature see Po et al. 2004). The next section introduces the social science research on public acceptance of WWT&R solutions. It focuses on the “yuck factor” and outlines empirical findings, relates them to explanatory frameworks and points out their political implications when it comes to defining solutions for re-use problems. The main findings and insights of empirical surveys are briefly summarized.

II.1. From “Toilet to Tap”

A number of (early) studies have investigated the association between *socio-demographic descriptors* and the acceptance of recycled water (Bruvold 1985). The evidence for links between education, understanding about risk and behavioral change is tenuous. One third of the surveys have found that people with a higher level of (formal) education are more likely to be supportive of water recycling (Dolničar and Saunders 2006). Thus, opposition to potable re-use is more likely to come from people of a lower socio-economic level, older people, women and those who are unaware of the practice of recycling water. Even if there is some empirical evidence for this linkage, there is no single, exclusive factor, but a complex mix of factors such as gender, age, income, demographics, prior awareness, and contextual issues that may be linked with people’s willingness to support water recycling (Po et al. 2004: 18).
Table 1 summarizes the factors that seem to contribute to the degree of public acceptance of water re-use according to survey and case study research from the late 1970s until early 2000.

[5] http://www.clw.csiro.au/awcrrp/documents/dillon-final-wra2000-oct00.pdf

Table 1 U.S. Public Acceptance of Water Re-use Seems to be Higher When:

- Degree of human contact is minimal
- Protection of public health is clear
- Protection of the environment is a clear benefit of the re-use
- Promotion of water conservation is a clear benefit of the re-use
- Cost of treatment and distribution technologies and systems is reasonable
- Perception of wastewater as the source for reclaimed water is minimal
- Awareness of water supply problems in the community is high
- Role of reclaimed water in overall water supply scheme is clear
- Perception of the quality of reclaimed water is high
- Confidence in local management of public utilities and technologies is high

Source: Hartley 2006: 116

Research has also shown that the acceptance of reclaimed water varies significantly depending on the *context* and the *scale of application* (Hurlimann and McKay 2006). The available social research carried out in Australia and the U.S. has consistently found that, despite broad acceptance of recycling per se and a large measure of public support for large-scale and non-personal uses of recycled water, communities have shown reluctance to accept municipal recycling, especially when domestic or personal uses are involved. People's support decreases as the degree of human contact with the recycled water increases (U.S. EPA 1992: 166; Hartley 2006). The surveys show that a substantial number of people in any community are likely to be opposed to uses of water recycling that involve drinking, cooking, showering, washing clothes, consumption of crops irrigated with reclaimed water, or other close *personal contact* uses (various studies cited in U.S. EPA 1992: 167). This is particularly true for potable re-use options, which have been assigned the derogatory label "toilet to tap" (Kennedy and Tsuchihashi 2005).[6]

These objections are explained by the "yuck factor." One of the main reasons given for the rejection is the psychological repugnance of recycled water (Bruvold 1985). U.S. water professionals introduced the term "yuck factor" to discuss the visceral reaction of displeasure and disdain expressed by the public as regards water re-use that may be tempered by an individual's proximity to the waste source. It describes an emotional response to the association with sewage. People cannot get past their disgust at the association with sewage and own an instinctive or cultural aversion to coming in contact with or drinking what was once sewage (Russell and Lux 2009). Academic and consultancy work in the area has been dominated by particular work from psychologists that prefer theories of disgust, models of attitude causation, and psychometric methods for measuring attitudes and determining the influences on them. The disciplinary bias enforces the disgust explanation that claims to

[6] Following this line, Po and Nancarrow found that generally, acceptance seemed to be higher on crops either not directly consumed by humans (e.g. pasture for livestock) or food crops that must be peeled or washed prior to human consumption (e.g. oranges, sweet corn) (2004).

demonstrate that, in the formation of attitudes, our emotions dominate our beliefs and values.
The "yuck factor" may also explain why the intensity of the public's concern is magnified when the re-use issues change from non-potable to potable (Hartley 2006). These attempts to empirically measure emotions are considered essential for attitudinal models that are developed to predict behavioral intention.[7]

II.2. The "Decide, Announce and Defend" Framework

In connection with "yuck factor" explanations, the "knowledge deficit" approach and the "decide, announce and defend" (DAD) strategy became the dominant framework employed to social marketing and to "educating" the public regarding the implementation of re-use schemes (Marks 2006; Bixio et al. 2006).[8] The next section questions the assumptions underlying the "yuck" explanation and the DAD framework, their political implications, and the practical consequences of framing the problem this way.
The "yuck factor" explanation goes hand in hand with the "knowledge deficit" approach that has been expressed in policy, planning, and research documents concerned with water recycling in the U.S. and Australia: As emotions such as disgust play a big role in determining behavior, the lack of acceptance can be mainly attributed to the ignorance of lay people and their misunderstanding of the risk (Gibson and Apostolidis 2001). There is a tendency to assume that lay people are not able or willing to comprehend specialist expert information and to accept rational arguments on the merits of technologies (Russell and Lux 2006). For some commentators, it reinforces their frustration that people are incapable of making rational judgment and are not persuaded by expert assessments. As a result, the gap between expert and lay people is deepened.
Public education and persuasion to encourage acceptance of technological solutions are accentuated in water management literature and policy. The "knowledge deficit" approach has led many in the water industry to assume that the public's willingness to accept WWT&R can be changed through **education** about health risks or through **demonstration** of benefits of its application (Gibson and Apostolidis 2001). Based on the assumption that people need more expert information to correct misperceptions or to overcome their emotions, the main challenges for water utilities became how much of that knowledge must be given to the "ignorant" public to convince it (Russell and Lux 2009). Some of these views are reflected in publications endorsed by leading water associations in the U.S. If the public were better informed, provided with more facts and figures, they would overlook the link with sewage and they would accept it more readily. This assumption explains why the demonstration of benefits became a big issue in different re-use communities all over the world.[9] Water re-use

[7] It is claimed that the establishment of targets for reusing treated wastewater requires the development of a tool that is able to predict the likely community acceptance of particular re-use schemes. Thus, the Australian Research Centre for Water in Society (ARCWIS) developed a hypothetical attitudinal model to measure the likely behavioural intention of the community in relation to proposed re-use schemes. This experiment aimed to develop measures of "emotion" that come into play when people consider using recycled water or products grown with recycled water (http://www.clw.csiro.au/research/water/arcwis/).

[8] The importance of marketing in the context of recycled water has been pointed out by numerous researchers in the past: A number of studies have been conducted in various scientific disciplines that can be classified as marketing-related research, the majority of which has been conducted in the late sixties and seventies in the U.S. (Dolničar and Saunders 2006).

[9] The spectrum of benefits ranges from economic cost-savings to creating values for the environment

projects were associated with pleasant things the public enjoys and approves of. For instance, reclaimed water was put in an attractive setting and the public was invited to look at it, sniff it, picnic around it, fish in it, and swim in it (cited after Dolničar and Saunders 2006). Much can be said about the adequacy of the "yuck factor" explanation but most worryingly it offers little guidance on how people's responses might change. Paradoxically, its proponents swing between despair that this gut reaction will be impossible to counteract, and calls for more effort to educate and persuade (Russell and Lux 2006).

The DAD framework can also be characterized by its "we know what's best for you" attitude. DAD based approaches to water management reinforce technical *closure* of the debate by restricting the range of response options to narrowly defined technological propositions and perceptions of risk that are determined by experts. While it also distracts attention both from the issues surrounding decision making and from proper consideration of other options, no alternatives to predetermined technological options are offered. Decentralized solutions, for example, are currently excluded (though not always necessarily intentionally) from planning practices. Up to the present, water recycling has been primarily framed by the water industry in terms of large-scale effluent treatment and transfer schemes or centralized municipal recycling. This is replicated in and reinforced by recent policy initiatives (BMU/ UBA 2007). According to the DAD framework, the public is supposed to play a passive role by providing ex-post acceptance for predetermined technological choices, thus reducing public involvement to tokenism. Different case studies show that, with notable exceptions, the water and sewerage industry and authorities have been in many countries reluctant to engage with the public seriously, and have kept planning processes regarding particular re-use options informal and confidential (Marks 2006; Russell and Lux 2006).

II.3. From Disgust to (Mis-)Trust

Re-use projects based on the DAD framework proved to be ineffective. Research evaluating these experiences reveals several reasons why the implementation of these strategies has failed:

First, according to the "deficit" approach lacking acceptance is mainly caused by the public's missing understanding of science and can thus be settled by more and better expert knowledge. Case studies, in fact, show that informational and educational activities contributed to an increase of public support but at the same time they added to controversies rather than settling them (Hartley 2006). As soon as an issue became salient, it happened to be polarized in the scientific and expert communities (Marks 2006). In California, members of the scientific and technical community, for instance, disagreed over the public health viability of indirect potable water re-use,

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and health and social, symbolic values such as community and capacity building at the local level (Marks 2004). Other observers highlight not only material but also symbolic values, such as value created by the inclusion of water re-use in integrated water resources planning and other aspects of water policy, as well as the implementation of water projects resulting in the long-term sustainability of our water supplies (Miller 2006). At the same time, researchers and engineers also recognized that benefits of water re-use often go unrecognized or are difficult to quantify, and are therefore not adequately reflected in monetarized values. They also call for pro-active policy and promotion strategies from interested stakeholders that recognize the beneficial effects the re-use can provide (Huertas et al. 2008; Hochstrat et al. 2008) and disseminate knowledge regarding the benefits (Salgot 2008).

with major water resource professional associations and respected research and expert panels taking opposing positions. The technical and scientific contributions introduced not more certainty and harmony but greater uncertainty into the public debate. The uncertainties can be accompanied by more intensity in the opposition to, and expression of, public concerns (Hartley 2006: 117). Experts and scientists called upon to resolve divergences, often proved to be a recipe for discord rather than harmony (Jasanoff and Wynne 1998). Problems with uncertainty and expert conflict tend to reduce the power of science as a "harmonizing force" and often become the cause of controversies themselves.

Second, many surveys indicate trust and credibility issues as a pivotal factor for addressing acceptance. When respondents are asked to explain their opposition to potable re-use, the emergent theme is distrust: distrust in both the technologies' and the agencies' ability to control risk (Po et al. 2004: 14). Survey results are in detail:

- Even if scientific studies indicate relatively low risk for reclaimed water applications such as landscape irrigation, residents may continue to doubt the veracity of such studies or the reliability of treatment systems. Likewise, belief that the best technologies can remove all impurities and pathogens from waste water is in decline. This implies that further factual information would have little effect on the public's trust in technical experts and the organizations they represent (Stenekes et al. 2006). This mistrust in wastewater utilities reflects the decline in trust and confidence towards public agencies and officials in the U.S. in general (Hartley 2006).
- At the same time, there is growing empirical evidence that controversies concerning water recycling are coupled closely with personal values and the quality of social networks. People trust their own personal impressions of water quality (often based upon the water's cloudiness or turbidity) more than experts (Hartley 2006).

These empirical results can be explained by sociological concepts of trust (see Giddens 1990). Acceptability is thus a function of the degree to which the institutions which are responsible for management of risks are trusted (Short 1984; Marks 2006). As the "basic trust" in sewerage agencies and the taken-for-granted attitude towards purity of drinking water is challenged, maintaining trust becomes a central issue in controversies on WWT&R, especially when it is felt that the agencies in charge are increasingly inaccessible to people. Under these conditions, trust has to be created by actively involving the public (Marks 2006).

III. MOVING BEYOND „YUCK" THROUGH STAKEHOLDER CONSULATION

III.1. Moving from Psychological to Institutional Analyses

In the aftermath of the resistance against several re-use projects in the U.S. and Australia, a paradigm shift in social science research and integrated research projects has taken place.[10] The discontent with "yuck" explanations and with "deficit"

[10] The Water Environment Research Foundation in the United States funded an interdisciplinary and integrative social science study on public perception and participation in water re-use within the U.S. It employed a three-phased research protocol consisting of a literature review and three comprehensive case studies, including interpretive white papers from five different social science disciplines and public health and environmental engineering scientists, a multi-stakeholder workshop to promote integrative, interdisciplinary analysis of the literature and case study findings, and peer-review these among twenty-one social science and water resource management experts (Hartley

and DAD approaches contributed to the shift from social acceptance and then on to active public engagement and governance issue in water policy and management (see Figure 1). Water management is framed now as a multi-dimensional and multi-stakeholder challenge, of which technological innovation is only one of many important foci for research. The same shift can be observed in the Australian and European Aquarec projects (EU_ Project: Integrated Concepts for Re-use of Upgraded Wastewater (Aquarec) http://www.aquarec.org/).

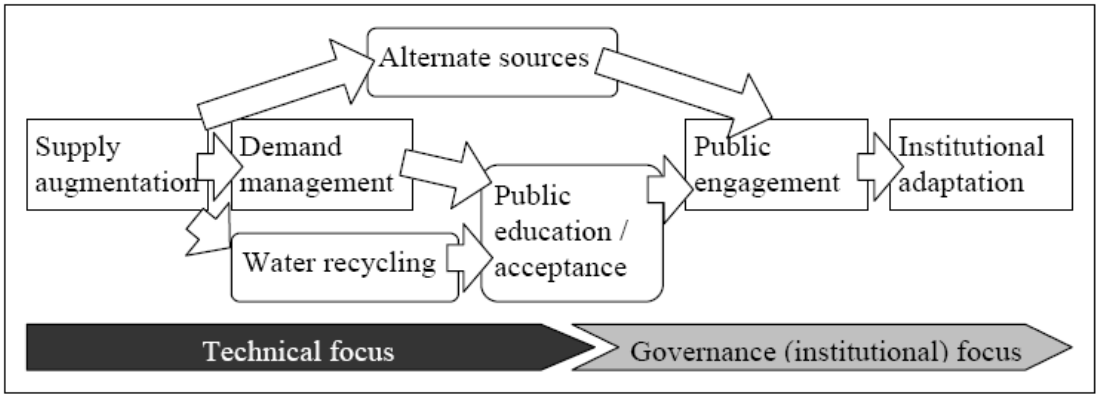

Figure 1 Changing paradigms and foci of water management

Political science approaches in general and "institutional"[11] approaches in particular promise to offer an alternative reading of the opportunities and failures of re-use projects. They are part of a new generation of research that was set up to evaluate the first generation of practical re-use projects. Researchers in Australia and the U.S. come to the conclusion that quantitative social research fails to explain the lack of progress in policies promoting water recycling. Despite evident difficulties experienced in the cases mentioned, there has been inadequate exploration of the reasons for the lack of success of water recycling by the water industry and their implications for water management institutions. The second generation of social science research was thus set up to understand *why* the public holds the perceptions they do and what public consultation options exist to address water re-use more constructively. The latter also shifted from quantitative measurements of perceptions and attitudes to qualitative explanations and interpretations. From this perspective, resistance to recycling is not mainly caused by emotional responses guided by disgust and the "knowledge deficit" of lay people but owed as much to the lack of consultation, to the mistrust that the DAD approach reinforced, and to the siege mentality that authorities defended as soon as opposition emerged (Russell and Lux 2009). As empirical support for the DAD strategy declined, a more nuanced view of

2006).

[11] An "institutional" approach is taken to ground the analysis in an understanding of the way water use is governed: it is based on the assumption that institutional frameworks are made up of regulative, cognitive, and normative rules, and are (re-)produced through the interaction with what is known, what is valued, and how this is reflected in organized activity (Stenekes et al. 2006; Colebatch 2006; Livingston et al. 2004).

the role of negotiations, community involvement and stakeholder consultation emerged to take its place. Based on institutional approaches, different authors claim that not the acceptance itself, but the assumptions behind the current rhetoric of "public acceptance" and the DAD framework can be seen as the main hurdles for achieving successful water recycling (Colebatch 2006; Stenekes et al. 2006; Russell and Lux 2009). Research based on these approaches examines users' discourses, frameworks and practices concerning solutions for providing water and handling waste. It focuses on the ways in which the WWT&R solutions have been negotiated within this institutional context by different stakeholders (Stenekes et al. 2006; Baggett et al. 2006). In this perspective, the major sources for difficulties in implementing WWT&R projects may well involve not only insufficient public understanding of water and wastewater issues, but may also stem from contextual circumstances and fundamentally divergent problem frames among stakeholders (ibid). These approaches assert not to seek the acceptance of a predetermined technological system, as supposed by technocratic approaches, but to arrive at a sustainable *outcome* such as improvement of the quality of management decisions, public support for these decisions, and local capacity for system maintenance.

III.2. Taking the Public Seriously: Creating Opportunities for Informed Deliberation

Overall, the consistent theme that emerges from experimenting with and evaluating water re-use is that these projects require wider consultation in project design, implementation and management (Khan and Gerrard 2006). These experiential results are complimentary to recent theoretical and conceptual developments in stakeholder consultation and participative planning. If people are to reach an informed, reasoned and robust evaluation of WWT&R options, both argue, there is growing need for constructive public consultation. Opportunities and mechanisms for consultation and negotiation about related issues between various stakeholders, and for a greater thematic scope, should therefore be encouraged (Hartley 2006; Russell and Hampton 2006).

Different authors also highlight, without discounting the potential positive role of public education in water management, the importance of two-way, bottom-up and reciprocal dialog about deeply held values established and maintained between stakeholders. As an alternative to technocratic top-down education and demonstration processes, deliberative consultation mechanisms are thought to contribute to both, the promotion of a mutual understanding between actors involved and a bottom-up dialog on WWT&R solutions (Hartley 2006; Russell and Lux 2009). There is a growing body of public participation literature supporting this notion, although not all those involved in water management acknowledge the value of public engagement and stakeholder consultation (Friend and Coutts 2006).

In different research projects such as AQUAREC the *need for a best management framework* for providing guidance for water professionals and utilities to engage constructively with local communities and other key stakeholders on challenging, contentious issues, has been emphasized (Hochstrat et al. 2008; Hartley 2006). These best management frameworks are developed as alternatives to the former education and demonstration strategies. They are based on multidisciplinary research that integrates diverse social science perspectives and practical utility management knowledge (Friend and Coutts 2006; Hartley 2006).

At the moment the need for public consultation on infrastructure projects and sensitive scientific and technological issues is widely acknowledged, at least in the abstract. There are many arguments for improved stakeholder consultation in WWT&R projects, but perhaps the main argument refers to the added procedural justice and legitimacy of any decision, thus creating active trust and credibility. A comparison of principles from different U.S. American, Australian and European water management frameworks shows that key principles are basically identical same: openness, transparency, accountability, and information.

- In order to increase the legitimacy and efficiency of the implementation, stakeholders – those who may be directly or indirectly affected by the WWT&R project – have to be involved from the start. The consultations are thus thought to include not only government representatives, politicians, water industry professionals but also the media, business and stakeholders groups, as well as the general public (Baggett et al. 2008).
- If the water re-use option has been actively and publicly deliberated, it is more likely to be successfully implemented and to enjoy ongoing acceptance. Thus, consultation must begin long before a project is conceptualized and continue throughout the life cycle of any project. It has to be highly visible throughout all of its stages, including planning, construction, implementation and operation.
- This also suggests that multiple sources of information and various methods of communication and consultation are required. Deliberations are set up to include complete information on the status quo (including instances of "unplanned" and existing potable re-use). As an alternative to the "we know what's best for you" culture, key stakeholders receive the opportunity to make an *input* that can complement (or challenge) the conventional expertise knowledge of technical experts, planners, and researchers, producing results that go beyond the capabilities of methods of policy-making.

The literature on public consultation also suggests that the breadth in terms of actors involved mainly contributes to the opening up of the debate and the breadth of the spectrum of available solutions. As a consequence, no single technical option is predetermined, and several alternative options are considered (Hartley 2006; Russell and Lux 2009).[12] Different case studies in the U.S. and Australia make a compelling case that paying attention to these principles contributes to the establishment and maintenance of public confidence and trust (Baggett et al. 2008; Friend and Coutts 2006; Hartley 2006; Russell and Lux 2009). Even if broader consultation by all stakeholders affected by WTT&R solutions are currently proposed, such initiatives are not yet widespread and the realization of far-reaching claims is the exception rather than the rule. Thus, the knowledge base has been limited to both technical engineering and economic aspects up to the present date.

III.3. Institutional Requirements

Empirical research also revealed that WWT&R projects are very dependent of the particular context of their implementation. The decision making context and the process of institutionalizing consultation projects proved important features in enabling and/or constraining the implementation of WTT&R. Different research groups draw the conclusion that research on public involvement needs to go beyond the factors affecting public acceptance and involve an examination of the social,

[12] There should be room for negotiation on the level of treatment required for the agreed purpose; whether drip or sprayer irrigation is used; and whether indoor uses are included.

institutional, and cultural contexts of specific cases (Colebatch 2006; Marks 2003; Stenekes et al. 2006).
Social science research evaluating different practical WWT&R projects demonstrates that novel WWT&R solutions would require far-reaching adjustments in infrastructure, management practices and institutional arrangements. All over the world there is a widespread realization of the *mismatch* between innovative solutions and the existing institutional setting of water management. From this perspective, it is the misfit between ambitious concepts and established institutional arrangements and political culture that partly explains the so far only modest progress in water recycling projects (Livingston et al. 2004). In addition, the reluctance of water agencies to move away from traditional paradigms of water management presents a major constraint. According to institutional approaches, decentralized options present an alternative to the existing centralized structure of water management. Water recycling emerges, for instance, not simply as a technical alternative to the present practice, but as a challenge to the existing institutional set-up of water use, particularly with respect to the place and role of water users (Colebatch 2006). The need for institutional frameworks in which stakeholders are seen as active participants and for democratizing power relations remain contested (Marks 2006). Comprehensive institutional innovations are expected to encounter resistance as soon as they challenge the established allocation and distribution of decision making authority, power and resources (Livingston et al. 2004; Stenekes et al. 2006). Many officials of water authorities are thus skeptical of decentralized schemes, for instance, that call for more, broader community involvement. These inconsistencies will have to be carefully reviewed if water recycling is to develop into a viable option.

IV. CONCLUSION

In current social science discussions on WWT&R public acceptance is widely used as *the* critical factor to explain the lack of demand and the implementation deficit of innovative solutions. This paper demonstrated that the failure of recent WWT&R projects can be understood not simply as a failure to gain public acceptance (in any particular case) but as the result of a framework that limits the role of the public to ex-post legitimation of predetermined expert solutions and thus constrains the definition of both the problem and its acceptable solution. Different water agencies have recognized the central role of consultation in the management and infrastructure planning but the degree of consultation and the role of the public, however, remain contested. As shown in section II, conventional reactions to WTT&R solutions are framed around the idea of a “yuck factor”, thereby perpetuating a dichotomy between experts and the laypersons. Research evaluating initiatives based on the “deficit” and DAD framework show that they are of limited value in explaining public responses, and even counterproductive in formulating strategies for increasing public support. Difficulties arise in part as water agencies tend to seek acceptance for predefined technological propositions rather than engaging with the public in addressing problems, thereby contributing to growing distrust and fostering controversies.
These empirical findings stem from the Australian and U.S. American context. It is an empirically open question whether they can be readily applied to other regions that are starting to implement WTT&R projects. One of the lessons learnt from former cases is that a commitment to the principles of openness, transparency and accountability can contribute to build public confidence and trust required to engage with the public on contested water issues. At the same time a one-size-fits-all model

cannot work because the most appropriate ways to achieve the principles vary from case to case and are dependent on the particular context (Russell and Hampton 2006). As themes as information and participation are not independent, discrete variables, there are no checklists of “to-do's” that exist for establishing public confidence and trust. Thus, it is important to assess the context in which a water re-use initiative is operating (Hartley 2006).

Social science research also indicates that robust WWT&R solutions require institutional arrangements that enable open consultations to take place in an integrated fashion, making room for lay as well as expert input that could also offer guidelines on how to proceed. As shown in section III, empirical findings also point to the mismatch between innovative solutions and institutional framework that tend to constrain the range of actors involved and reduced the number of acceptable options for water management. The interest in identifying the factors that influence public acceptance has not been matched sufficiently, however, by an analysis of the context of existing institutional frameworks for water planning. Thus, there is a growing need to explain the features of the institutional arrangement that constrain or enable the effective knowledge production, consultation and decision-making processes.

The main issues are, first, that enhancing accountability through stakeholder consultation will need to be accompanied by a re-examination of the institutional constraints placed on acceptable solutions to water use problems and, particularly, the way water use options are defined and evaluated. Second, it is critical that agencies continue to cope with the issue of how to adequately include and represent the knowledge, views and values of a diverse public and how to enforce institutional adjustments that effectively integrate novel solutions into existing regulatory structures (Stenekes et al. 2006).

Further understanding is also required on how processes of planning and managing can best be structured and facilitated (Baggett et al. 2008). Although these initiatives will hardly eliminate conflicting values and interests concerning risk, such shifts in policy may represent the beginning of a new culture of engagement and may go a long way toward improving accountability and transparency.

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