USE OF A PUBLIC PERCEPTIONS STUDY TO ASSIST POLICY MAKING FOR RECLAIMED WATER REUSE

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EXTENDED ABSTRACT

Water reuse has different driving forces. For Cyprus, a water scarce country, reclaimed water can be a significant supplemental water supply. An assessment of the public acceptance of potential wastewater reuse is necessary, if a sustainable water reuse scheme is to be achieved. An effort to identify the areas of most concern among various stakeholders in Cyprus, co-financed by the European Regional Development Fund and the Republic of Cyprus, was undertaken.

Specially-designed questionnaires were distributed to three distinct population groups; (a) farmers (N=100), (b) water experts from the private and public sectors (N=100) and (c) the general public (N=850). The questionnaires comprised of 40 questions and were divided into distinct sections such as economic factors, education and awareness, social / cultural factors, and trust in processes, scientists, and regulatory authorities.

Results obtained showed that 50% of survey participants (excluding water experts) are not aware of the origin of recycled water, and 35% ignore the mere existence of wastewater treatment plants, while 80% of the public would like to know more about water recycling. 80% of respondents believe that environmental education in schools is a more effective measure for promoting water reuse schemes, in contrast to only 50% of people who believe that support from the government would help achieve similar results. While 70% of respondents consider water bills high enough already, an equal percentage of people is willing to pay as much as an additional 10% on their water bill, if this were to promote a sound water recycling scheme. 70% of the people think that subsidies would better help promote water reuse schemes, while 50% of the people feel that direct enforcement or fines would not help. 80% of respondents accept recycled water for such uses as landscape irrigation and fire-fighting; however, this acceptance percentage drops sharply, to 50% for crop irrigation use, 45% for groundwater recharge, and to 30% for augmentation of water in reservoir dams (non-potable). Only 20% of the participants believe that there is adequate control and proper checks for recycled water quality, paralleling the fact that only 30% of the people trust the authorities.

Results suggest that policy emphasis should be placed on education, conducted through academic institutions. Additionally, a public image enhancement of the Authorities would help. Economic instruments should follow market-based mechanisms and subsidies, as opposed to direct enforcement or taxation. Some increase in water recycling fees would be accepted, if coupled with an educational campaign.

Keywords: Public Perceptions, Survey, Reclaimed Water, Recycled Wastewater, Water Reuse, Cyprus, Stakeholders Perceptions, Policy Making.
1. INTRODUCTION

Water reuse offers a reliable water supply option, relatively unaffected by drought. It conserves water resources and may offset the need for more expensive, geographically remote, and environmentally disruptive alternatives. Water reuse refers to the use of treated municipal wastewater as a source of supply for applications that can enable a community to augment its water supply. With technology advances in wastewater treatment, the opportunity for water reuse has never been more viable. The benefits of using recycled water include protection of water resources, prevention of coastal pollution, recovery of nutrients, groundwater recharge, and sustainability of water resource management (Angelakis & Bontoux, 2001; Asano, 2001). Currently practiced water reuse applications include irrigation, industrial use, construction water, vehicle washing, toilet flushing, and fire-fighting.

Many communities face limitations in water supply because of environmental conditions or water allocation policies. Further, agricultural, municipal, and industry are in competition for limited water supplies. Cyprus, like many other Mediterranean and Middle Eastern countries, suffers from chronic water shortage. Groundwater resources are limited, and a significant part of the rainfall, the main source of water, is captured in reservoir dams built throughout the island. Variability in annual rainfall is characteristic for the island and droughts are frequent and sometimes severe. The variation in rainfall is not only seasonal but spatial, with large parts of the island witnessing rainfall as low as 300 mm/year. The availability of water per capita in Cyprus was reported to be 1,208 m$^3$ per year, thus putting the island in the category of water-stressed countries. It is expected that by the year 2025 the per capita water availability will drop under the 1000 m$^3$/year “benchmark” of water-scarce countries (Hinrichsen et al., 1998). In addition to the many reservoir dams constructed on the island, a number of additional steps have been taken by the Government to meet the increasing demand for water. For example, desalination plants that are providing potable water to various cities, have been built and are operating on the island. Under such a scenario, the reuse of wastewater in Cyprus offers opportunities of reducing demand on the severely scarce potable water resources, and alleviating other, currently in-use, methods of water augmentation.

While development of guidelines and standards for non-potable and indirect potable reuse that provide the highest level of safety and reliability to the public is a challenge to public officials, and scientists, worldwide (Anderson et al., 2001; USEPA, 1992; WHO, 1989), it is often a greater challenge to water managers to successfully implement any water reuse program. When initiating any water reuse program that is to succeed, it is necessary that the specific environmental and social/cultural realities of countries or regions are taken into consideration (Hartley, 2003; Marks, 2003; Po et al., 2003). This point is well emphasized by Dishman, Sherrard, and Rehun (1989), who stated that “…the issue of public acceptance could kill the (reuse) proposal. …a strategy (based on applied behavioral analysis and social marketing) should be developed to deal with public unwillingness to drink reclaimed water (p.158)”.

Some researchers support that public education is the key to the successful implementation of a water reuse program (Katz & Tennyson, 1997; Wegner-Gwidt, 1998). However, others support that the factors governing the public’s attitude are more complex than what an education campaign could address (Dishman et al., 1989; Gibson & Apostolidis, 2001; Savage, 1993; Sjoberg, 2001). It remains that the extent to which a community embraces water reuse is its own decision. However, it is up to the public officials, and other stakeholders, to support research that would allow a water utility to implement the level of water reuse that the community decides is appropriate.
2. RESEARCH OBJECTIVES

A careful assessment of the public acceptance and of the extent of potential health risks involved in wastewater reuse is necessary, if a sustainable water reuse scheme is to be implemented.

Our work seeks to identify the areas of most concern among different possible user groups for reclaimed water, in Cyprus, and suggest mechanisms that can promote a sound water reuse program on the island. This is achieved, in part, through a public survey that examines the public awareness, ideas, and concerns of different communities in the country. Using the results obtained, we suggest possible appropriate action to be taken towards incorporating recycled water into a possible future Integrated Water Resources Management Plan. The exploration concentrates on the social / economic aspects and figures out to what extent the social habits; culture, heritage, mentality, and understandings of various communal groups, as well as economics affect the attitude towards water reuse.

3. METHODOLOGY

Our methodology involved a series of actions that are most commonly used when developing a risk perception study. Such actions include questionnaires, interviews, and workshops. However, the principal method for obtaining information was through the use of a questionnaire, which was used by field workers in personal interviews of participants from three different stakeholder groups; the general public, water experts, and farmers.

3.1. Data Collection Tool (Questionnaire Development)

Three different questionnaires, each targeting a separate stakeholder group, were prepared. These questionnaires were used to solicit the opinions / perceptions of important stakeholders of a water-reuse program (1000 people in total) in Cyprus. The demographic characteristics of the sampled population, their education and income levels, as well as the social status of these individuals were considered. Three target group categories were identified for the purposes of this research; 1) farmers, 2) the general public, and 3) water management experts and institutions. The farmers’ questionnaire was applied to the agriculture related individuals in representative agricultural communities. The general public’s questionnaire was applied to households in both rural communities as well as in urban settings. The expert’s questionnaire was applied to the persons in the private sector who specialize in water resource management or in wastewater treatment and reuse, or to Government officials, including elected and designated individuals, academics, interested NGOs and other concerned entities. The character and content of the questionnaire for each target group category was modified according to the characteristics of the group investigated.

The questionnaires were divided into different sections; “general information / demographics”, “education / knowledge”, “economics”, “social / cultural practices”, and “trust in processes and institutions”.

The questionnaires targeting the general public and farmers were headed off by two “screening questions” that sought to identify whether respondents knew anything on the topic of recycled wastewater and water reuse. After the screening questions, a brief introduction to the project followed, which was delivered by interviewers / field workers during data collection. Following this introduction, the questionnaires were structured as follows:
Questionnaire for the General Public:
A total of 42 questions were included (including demographics). Seven of those questions revolved were included under the section of "Education / knowledge", another seven questions came under the category of "economics", eight questions were under the category of "social / cultural practices", nine questions under "trust in processes and institutions", and, finally, 12 elements concerned demographic information gathering.

Questionnaire for Farmers:
A total of 47 questions were included (including demographics). Eight of those questions revolved were included under the section of "Education / knowledge", another six questions came under the category of "economics", nine questions were under the category of "social / cultural practices", 12 questions under "trust in processes and institutions", and, finally, 12 elements concerned demographic information gathering.

Questionnaire for Water Experts:
The questionnaire for experts did not include the "screening questions" used in the prior target groups. Instead, an introduction to the projected headed the questionnaire.
A total of 46 questions were included (including demographics). Eight of those questions revolved were included under the section of "Education / knowledge", another eight questions came under the category of "economics", nine questions were under the category of "social / cultural practices", eight questions under "trust in processes and institutions", and, finally, 13 elements concerned demographic information gathering.

The majority of the items in the questionnaire involve stating the level of agreement on a 5-point scale to a series of statements regarding perceptions, attitudes or knowledge on water reuse issues (ranging from absolute disagreement to absolute agreement, or equivalently ranging from absolutely negative to absolutely positive attitude, etc.).

The questionnaires used during the study can be viewed, in full, by visiting the project’s website at http://recycled-water-perceptions.i4-services.com/

3.2. Sampling Procedure

The questionnaires were distributed to three distinct population groups, using in each case a different sampling and data collection approach, as detailed further down. These groups were 1) farmers (N=100), 2) water experts from private organizations, agencies or related governmental entities (N=100) and 3) the general public (N=800).

In the case of the general public, it was important to juxtapose the potentially differing perceptions among populations residing in urban and rural environments. It is of note that many of the previously published studies in the literature on public perceptions of water reuse restricted their investigations to a single city or even community. In this case, an overall quota of 70:30 (i.e. a split of the overall sample into 560 Vs 240 people from urban and rural areas respectively) was a priori decided to approximately reflect the urban-rural distribution of the population in Cyprus. The recently published figures recorded in the latest census of the population confirm that, in 2011, a proportion of 67.4% of the population resided in urban and 32.6% in rural areas of the island. Educational attainment, marital status, gender, and age groups observed in our study (Figure 1) also follow closely figures published in the 2011 census for Cyprus.

The size of the sample for each population group under study was determined using precision analysis (i.e. restricting the margin of error in parameter estimates to 10% or less across all three groups) and confirmed in terms of its statistical power to detect differences in the responses between the three groups under study using power analysis.
Different sampling methods were adopted in order to sample study participants from each of the three groups under investigation (i.e. purposive & snowballing in the case of experts, convenience & snowballing in the case of farmers and cluster & quota sampling in the case of the general public).

4. RESULTS

The select results presented are limited to the items that show statistical significance, according to the methodology described above. Also, we are presenting results that better guide us in suggesting appropriate action / policy measures for a successful water recycling scheme to be implemented in Cyprus.

4.1. Education / Knowledge

Results obtained show that a significant percentage of people have serious misconceptions of wastewater treatment and reuse. For instance, 50% of survey participants (excluding water experts) are not aware of the origin of recycled water, and 35% ignore the mere existence of wastewater treatment plants. Also important is the fact that almost 80% of the public, 55% of farmers, and even 35% of water experts listed the “enforcement of water savings measures at home” as one of the top three measures for achieving overall water savings in the country. This belief, obviously, does not take into consideration that only 20% of the overall water budget of the country is devoted to domestic use, while 65% is devoted to agriculture. This misconception may also stem from the fact that Water Authorities in Cyprus have been engaged in a long-term campaign promoting water savings measures at home. Only 10% of the public and 15% of farmers thought that “revisiting our agricultural policy” would be a meaningful measure for water savings in Cyprus, in contrast with 40% of water experts. Figure 2 juxtaposes the responses received for “water savings measures at home” versus “revisit of agricultural policy” as two solutions of choice. A response of “0” means that this “solution” was not chosen by people, while numbers “1, 2, 3” are priority choices.
Further, our study showed that respondents are eager to learn more about water reuse and they also value environmental education. Specifically, almost half of the respondents disagreed with the statement that “there is proper training / education / awareness on the topic of recycled water in Cyprus”, while 80% of the public would like to know more about water recycling. Another 80% of respondents believe that environmental education in schools is a more effective measure for promoting water reuse schemes, in contrast to only 50% of people who believe that support from the government would help achieve similar results.

4.2. Economic factors

While 70% of respondents consider water bills high enough already, an equal percentage of people is willing to pay as much as an additional 10% on their water bill, if this were to promote a sound water recycling scheme. More water experts are willing to pay additional fees, and by as much as 20%, when compared to farmers. The general public is willing the pay the least extra amount.

From the respondents who were not willing to pay more for a water recycling scheme, more than 70% feel that it is the government's responsibility to treat wastewater, out of taxes already paid, while 60% of respondents do not trusts that the government will do what is necessary for a more successful water recycling program, even after price increases. Also, from the respondents who are not willing to pay more for sound water recycling schemes, 80% of the public and 90% of farmers justify this by saying that water bills are already high enough, as opposed to only 40% of water experts who share a similar view.

70% of the people think that subsidies would better help promote water reuse schemes, while 50% of the people feel that direct enforcement or fines would not help.

4.3. Social / cultural practices and restrictions

80% of respondents accept recycled water for such uses as landscape irrigation and firefighting; however, this acceptance percentage drops sharply, to 50% for crop irrigation use, 45% for groundwater recharge, and to 30% for augmentation of water in reservoir dams (non-potable). This was an expected outcome, since people are willing to accept a use that is as distant from their everyday lives as possible.

45% of the public, 35% of farmers, and 15% of water experts would not buy products produced with recycled water. Also, 90% of the public would like to have products produced with recycled water to be accordingly labelled in stores. This is different from 65% of water experts and 70% of farmers who have this requirement. 25% of farmers do not want separate labelling of products, possibly due to the fact that they are the ones
who are cultivating crops with the use of recycled water, and who fear that their products will be at a disadvantage.

80% of water experts would trust sending their children to a school that uses recycled water for needs other than potable, while only 45% of the public and 35% of farmers exhibit similar trust. These percentages sharply increase (100% of water experts and 70% of the general public), for willingness to visit a park that is irrigated with recycled water, possibly due to the fact that people feel that they are more in direct control of their children.

The primary reasons listed by almost all participants were, in order of importance, the "presence of microbes", "odours", and the "yuck factor". The latter was significantly less for water experts than for other categories of respondents.

4.4. Trust in processes and institutions

While 70% of water experts feel that the authorities have the necessary knowledge for managing recycled water, only 33% of the general public and 48% of farmers share the same view. This may stem from the fact that many of the water experts sampled are part of the public service. However, only 20% of all respondents believe that there is adequate control and proper checks for recycled water quality.

Also, scientists are trusted more than the authorities by the general public (50% versus 33%), by farmers (68% versus 40%), and by water experts (85% versus 50%). While more water experts seem to trust the authorities, if the fact that 42% of the water experts sampled are part of the public service, it immediately seems that water experts are the ones who may not trust authorities the most.

5. CONCLUSIONS

Results suggest the adoption of certain possible measures if an effective water recycling program is to be implemented.

Specifically, emphasis should be placed on education, since people seem to have serious misconceptions about water use in Cyprus, as well as about recycled water. Any educational program should best be conducted through academic institutions, as opposed to by any governmental entity, since trust to authorities is not very high. Additionally, a public image enhancement of the authorities would also help in bringing about change.

It seems that an increase in water recycling fees could be accepted in Cyprus. If this fee increase is coupled with a proper educational campaign, acceptance by the public becomes even higher.

Also, it is also known that the country’s infrastructure hinders the, at present, effective implementation of a sound water recycling scheme. A prime example is provided by the fact that the largest wastewater treatment plant on the island (with a capacity of 30,000 m³/day) currently has no means of directing high quality effluent towards any specific user or use. Therefore, any water recycling fee increases should be properly used to improve much needed infrastructure.

Finally, care should be taken so that economic instruments employed will follow market-based mechanisms and subsidies, rather than direct enforcement or taxation.
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