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An Investigation of Water Awareness and Public Participation in Integrated Urban Water Management in Saudi Arabia

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**An Investigation of Water
Awareness and Public
Participation in Integrated Urban
Water Management in Saudi
Arabia**

Volume I

By

Abdullah Mohammed Almojser Alsaluli

PhD

September 2016



An Investigation of Water Awareness and Public Participation in Integrated Urban Water Management in Saudi Arabia

By

Abdullah Mohammed Almojser Alsaluli

September 2016

*A thesis submitted in partial fulfilment of the University's requirements for the
Degree of doctor of Philosophy*



Certificate of Ethical Approval

Applicant:

Abdullah Alsululi

Project Title:

Public and Stakeholders Participation in Integrated Urban Water Management in
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This is to certify that the above named applicant has completed the Coventry University Ethical Approval process and their project has been confirmed and approved as Medium Risk

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Abstract

This research presents an overview of interpretative analysis of water awareness and positive public participation in integrated urban water management (IUWM) in Saudi Arabia. The research targeted different stakeholders to investigate the current practices and visions, in order to determine the extent to which IUWM could be enhanced by positive stakeholder participation and public awareness. The study investigates the views of a number of key public stakeholder groups within Saudi society, all of whom have a public interface within the selected section of society. Data collection was through in-person administering of hardcopy questionnaires in Riyadh, Jeddah and Albaha, collecting responses from a wide range of stakeholder groups, including teachers, policy makers, water professionals and managers, environmental managers, technical practitioners and engineers, industrial managers, lecturers and researchers, and from the general public. A feature of the methodology for this project, in particular, is the identification of opportunities for transferring learning from UK experiences to the Saudi situation. Five water companies/managers in the UK, face-to-face interviews were used to collect data. Overall, this research focuses on the social-economic (political, economic and cultural) rather than the physical (environmental, ecological, hydrological) dimensions of IUWM.

The research is a significant improvement to current knowledge because it has evaluated the potential for public engagement/positive public participation in IUWM in Saudi Arabia. It has presented strong indications that the kingdom needs to move significantly towards this approach (IUWM) to current methods of water management and that public engagement/positive public participation should be seen as an important component. Therefore, the research proposes strategies for stimulating and harnessing public engagement in water issues.

The findings present that there is a need to develop stakeholders' knowledge by increasing current understanding relating to IUWM in the institutional, educational, environmental, industrial and social fields/sectors. In order to achieve that the process will occur optimally through building a strong foundation for collaboration within the water sector to encourage Saudi society to participate in the implementation of IUWM. This should be partly based on positive public participation resulting from high public awareness of water issues.

The project presents the public water awareness level of water issues and the potential role from different perspectives in raising levels of awareness and engagement in water management. In particular, the views of water managers from the UK were analysed in order to evaluate if these practices were transferable to the Saudi situation.

The analysis and evaluation of the data overview presents significant new knowledge that can contribute to the implementation of IUWM in the Kingdom of Saudi Arabia. The proposed paradigm of this research demonstrates how a thorough knowledge of the needs and expectations of water users is essential in order to target campaigns to raise awareness and stimulate engagement in the process of IUWM. A successful campaign will be based on communication and this communication will in turn produce positive actions with respect to water use.

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Chapter 1: Introduction

1.1 Background and the current Saudi situation

The Kingdom of Saudi Arabia (KSA) has an area of about 2.25 million km² with a total population of about 30 million (Ouda, 2013). The scarcity of fresh water resources is a major challenge facing Saudi Arabia (Mahmoud and Alazba 2016a), this scarcity is threatening the economic development and political stability of many parts of the Middle East. KSA is one of the hottest and driest subtropical desert countries in the globe. With an average of 112 mm of precipitation per year (Mahmoud and Alazba 2014), much of the Kingdom falls within the standard definition of a desert. Water management in the KSA is facing major challenges due to the limited water resources and increasing uncertainties caused by climate change (Mahmoud and Alazba 2016b). The exploitation of subsurface water from deep aquifers also depletes resources that have taken decades or centuries to accumulate and on which the current annual rainfall has no immediate effect (Mahmoud et al. 2014; Mahmoud and Alazba 2014).

Water limitations are particularly severe in the Kingdom of Saudi Arabia. The major item of water consumption in KSA is the agriculture sector about 20 billion m³/year by the year 2000 (Mahmoud and Alazba 2016b). The agricultural water demands were 83–90 % of the total water demands during 1990–2009 (Mahmoud and Alazba 2016b). To address the water conservation policy, KSA has adopted a strategy to reduce agricultural water demands by introducing modern irrigation techniques, which lead to a decline in consumption of water for agricultural purposes, at an average annual rate of 2.5 % between 2004 and 2009 (Mahmoud and Alazba 2016b). This agricultural expansion occurred as a result of rapid increases in population and human activity and the establishment of large-scale water projects such as dams and flood control infrastructure (Mahmoud and Alazba, 2015). Moreover, poor resource management resulted in the overexploitation of natural resources, with adverse effects on sustainable development. Land cover conversion has resulted in land degradation, interfered with biodiversity and the ecosystem, and caused water stress (Mahmoud and Alazba, 2015).

Since the early 1990s, the concept of Integrated Water Resources Management (IWRM) has been known throughout the world (Mitchell 1990,2005; Dublin Statement 1992; Jønch-Clausen

2004; Swatuk 2005; Medema et al., 2008; Jeffrey and Gearey 2006; Cook and Spray 2012; Medema and Jeffrey 2005). IWRM is based on the perception of water as an integral part of the ecosystem, a natural resource and a social and economic good, whose quantity and quality determine the nature of its utilization (Al Radif 1999; Pahl-Wostl et al., 2007; Pahl-Wostl et al., 2011; Butterworth et al., 2010; Mostert 2006; Petit and Baron 2009; Giordano and Shah 2014). This approach incorporates policy options that recognize these elements, develop national water policies and base the demand for and allocation of water resources on equity and efficient use (Al Radif 1999; Petit and Baron 2009; Giordano and Shah 2014). In order to implement IWRM, it may be necessary to consider the strengthening of human resources development in terms of awareness creation programs, training of water managers, the development of new institutions that will serve and match this goal, effective information management, environment and development, the integration of water planning into national economy and financing and scientific means (Jønch-Clausen 2004; Swatuk 2005; Medema et al., 2008; Jeffrey and Gearey 2006; Cook and Spray 2012; Medema and Jeffrey 2005).

On the national level, there are a few studies which have been conducted to measure the public awareness of water shortage through the promotion of IWRM. For example, Ouda (2013) designed a study to measure the public awareness of water shortage problem in Al Khobar City at the Eastern Province of KSA. Results from this study showed low-level of water shortage awareness among respondents (Ouda 2013; Ouda et al., 2013). Therefore, it is necessary to increase the public awareness of water shortage problem (Ouda et al., 2013). Another study conducted by Cosgrove and Rijsberman (2014) revealed that Saudi Arabia will face water stress, or scarcity conditions by 2025. The authors stated that the ratio of withdrawals for human use to total renewable resources (the criticality ratio) implies that water stress depends on the variability of resources, and this ranges from 20% for basins with highly variable runoff to 60% for temperate zone basins, with an overall value of 40% used to indicate high water stress. In order to overcome water scarcity, the officials and legislators of water resources in Saudi Arabia

have encouraged the promotion of rainwater harvesting to avoid the suffering associated with severe drought (Mahmoud 2014).

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Source: Cosgrove and Rijsberman (2014, p.25)

The population of Saudi Arabia has tripled since 1975, leading to an ever increasing demand for water despite the scarcity of acceptable quality resources. From the Central Department of Statistics and Information in Saudi Arabia, the total population is 28,376,355 according to the 2011 census. In addition, growth in the industrial and the agricultural sector has led to an increase in demand alongside excessive water pollution. Figure 1 shows high levels of water stress. Mahmoud (2014) reported that the agriculture water use in KSA is almost completely dependent on groundwater, which is difficult and expensive to obtain. While, water for domestic purposes has to be obtained by desalination, which is a cost-intensive process. Alternative supplementary water sources such as rainwater harvesting, wastewater reuse and desalination were introduced in several studies in the last decade (Mahmoud and Alazba 2016a, b; Mahmoud and Alazba 2015, Amin et al., 2014a, b; Amin et al.,2015). As a result of that, KSA have established more than 360 rainwater harvesting dams (Mahmoud and Alazba 2016a, b).

Some of the largest of these dams are located in the WadiJizan, Wadi Fatima, WadiBisha and Najran districts (Figure 2).

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Source: BISHA NET (2016)

The king Fahad dam in Saudi Arabia on WadiBisha is the biggest dam in the KSA, and considered to be the largest concrete dam in the Middle East. Regarding desalination plants, there are approximately 40 desalination plants, 27 of which are operated by The Saline Water Conversion Corporation (SWCC) which produces more than 3,000,000 cubic meters a day of potable water. Water is purified through a Multi Stage Flush (MSF) System and Reverse Osmosis (RO) (Bushnak, 1997). The world's largest independent water and power plant (Figure 3) (IWPP); has 2,745 megawatt power capacity and desalination output of 800,000 cubic meters per day, considered the world's largest integrated water and power project facility.

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Source: Marafiq (2016)

The IWPP with its 2,745 megawatt power capacity and desalination output of 800,000 cubic meters per day, is considered the world's largest integrated water and power project facility. Recycling plants in Riyadh and Jeddah have also supplied up to 40% of the water required for domestic usage in urban areas (Al-Zahrani, 2009). Through these different methods of supply, although people have enjoyed an improved quality of life, it has caused environmental destruction to a magnitude that cannot be predicted (Buchholz, 1993; McNelis and Schweitzer, 2001; Aburizaiza et al, 2013; Ulrichsen, 2013). In support of this, the United Nations World Water Assessment Programme through the UNESCO organisation (2009) has demonstrated that the Kingdom of Saudi Arabia (still one of the developing countries in providing villages and settlements with urban water system services such as sanitation water systems and potable water distribution networks). The Saudi government made strong commitment to support long term and sustainable development of freshwater resources against challenges of increasing demand, potential water quality deterioration, limited availability and future impacts of climatic change at all levels. To cater the above challenges, the government adopted rational approach to utilize groundwater resources by controlling aquifer development, well licensing and drilling, agriculture policy modification, production of non-conventional water resources, fully utilization of surface water resources and effective water conservation and efficient demand management

(Mahmoud, 2014). Recently, Ministry of Water & Electricity has implemented very ambitious nationwide water conservation program for efficient use of water which was focused on Water Demand Management (WMD) for domestic and non-domestic customers, organizational restructuring and progressing towards privatization which resulted significant reduction in water consumption.

Suleymanova (2002) explained that the Water Scarcity where water supplies are inadequate, two types of water scarcity can be identified that particularly affect developing countries as follows: Physical Water Scarcity and Economic Water Scarcity. Saudi Arabia shows Physical Water Scarcity in that water consumption exceeds 60% of the usable supply, and the Water supply therefore is insufficient to meet the demand of agriculture, the domestic and the industrial sectors in addition to satisfying environmental needs (Suleymanova, 2002). Also Suleymanova (2002) has shown that, in order to help meet water needs some countries such as Saudi Arabia and Kuwait import much of their food and invest in desalinisation plants which increases the cost of water to around twice that of the UK. In addition, Suleymanova (2002) revealed that Economic water scarcity when a country physically has sufficient water resources to meet its needs, but additional storage and transport facilities are required.

1.2 Aims and objectives

1.2.1 Rationale for this study

In light of the current situation in the Kingdom of Saudi Arabia, particularly the rising demand for fresh water and the limitation of its supply, public awareness campaigns have proved to be an effective tool in effecting behavioral changes amongst the public, using different marketing and media tools to spread the message of water conservation (Ouda et al., 2013; MOWE 2012). The campaign included production and transmission of many conservation messages via television, radio, and newspapers commercials. It provides with far contents and targets. However, more efforts need to be done through public awareness campaigns as recommended by Ouda et al., (2013) to promote integrated water management (IWM). An interdisciplinary integration of society, water politics, education and economics will be required in order to move away from the existing system of water management that depends on an ever-increasing

supply, into a modern urban system such as installation of water saving devices such as constant flow regulators and low capacity flushing toilets; highly efficient sanitation and irrigation equipments, public education and publicity programs on the importance of water conservation; and pricing water to reflect its strategic importance and scarcity value (MOWE 2012; Ouda 2014; Ouda et al., 2015). To achieve this new and important shift, we should initially focus on the realisation of integrated urban water management (IUWM) because by 2015, 91% of Saudi population will be in urban areas as estimated by Global Water Intelligence in the Pinsert Masons Water Yearbook 2009-2010.

1.2.2 Research questions

The main research question of this study is, to reiterate: *To what extent Integrated Urban Water Management in Saudi Arabia can be enhanced by positive stakeholder/public participation and public awareness?*

In order to fully address this question, the following sub questions have been formulated:

1. What is the current level of public awareness of water issues?
2. How much public engagement is likely?
3. How and to what extent can public engagement be stimulated to enhance integrated urban water management in KSA?
4. How and to what extent can public engagement be harnessed to enhance integrated urban water management in KSA?

This research aims to make significant contribution to knowledge through a comprehensive survey of water awareness and positive public participation in integrated urban water management (IUWM) in Saudi Arabia. The research will be carried out through analytical interpretation of data provided by recent original surveys. Through investigating the existing practices and visions of all stakeholders in relation to integrated urban water management applications, a clear picture of the current situation will be formed. This investigation, and its potential for utilising the active participation of the public and other stakeholders, will be an

essential foundation for all Saudi society to participate in the implementation of IUWM. It is for this reason that the research will focus on socio-political, economic and cultural aspects.

The main aim and objectives

The overall aim of this research project is to determine the extent to which Integrated Urban Water Management can be enhanced by positive public participation and public awareness. To address this (the main aim), the following objectives are the guidance and roadmap towards achieving the main aim of this study.

- Objective 1: Explore current water supply and management systems in Saudi Arabia.
- Objective 2: Investigate the current level awareness of water issues among the selected stakeholders in KSA.
- Objective 3: Evaluate how selected stakeholders influence public awareness to enhance the implementation of Integrated Urban Water Management in KSA.
- Objective 4: Evaluate how much public engagement is likely for enhancing the IUWM.
- Objective 5: Establish how and to what extent can public engagement be stimulated and harnessed.

1.3 Structure of the investigation

The thesis is structured in the following sections: chapter one is the introduction, chapter two is a literature review of both water management within KSA, and theoretical approaches to integrated water management (integrated water resource management and integrated urban water management). The overview of water management within KSA sets the scene for a new primary source of data. New data was obtained from both primary and secondary research. Once the rationale and need for this research was established in chapter two, chapter three discussed the justification of research methodology used for this research.

The primary research data was obtained by conducting interviews in the UK and distributing questionnaires in Saudi Arabia to three groups of stakeholders, collecting 220 responses from a wide range of stakeholder groups, including teachers, policy makers, water professionals and

managers, environmental managers, technical practitioners and engineers, industrial managers, lecturers and researchers, and from the general public who all have valuable insight on this topic and can share their thoughts and views on expansion and development.

The questionnaires were established in English then, they had been translated into Arabic, and after the analysis the Arabic quotations were translated into English. The researcher visited the KSA in order to distribute and collect the questionnaires. A total of 220 respondents participated and filled and returned the questionnaire in Saudi Arabia. In the UK, the researcher interviewed five water managers working within the UK water industry.

The method of analysing the interviews is totally qualitative. The questionnaires consisted of both quantitative and qualitative analysis based on the nature of the questions. In reality, the analysis of the majority of surveys questions was made through coding, thematic and interpretative analysis as a qualitative method. Chapters four and five analysed the answers obtained and the main research questions were answered (see Table 1):

Table 1 summarises the answers to the main research questions obtained after carrying out an analysis have been summarised. As depicted in the table, survey samples for the study were obtained from a various levels including the public and social level, education, academia, institutional level, environmental and industry. The wide range of sample levels suggests that the data and results obtained in this study are more reliable as they cover diverse levels of the population.

Table 1: Main survey samples and questions used in this questionnaire

Survey samples	Description
The public and social level	This assessed the current situation of public awareness of urban water issues in terms of attitudes and practices. It will investigate to what extent both Saudi nationals and non-nationals/foreign people have a responsibility towards their own water use.
Education	Education systems and the school curriculum has been analysed in terms of their contribution to water issues. The potential for schools to work together with a range of partners including schools and mosques
Academia	This investigated how researchers can participate positively in helping the achievement of IUWM and to what extent the academies can work together with the water authorities to improve public awareness.
The Institutional level	The effectiveness of existing campaigns to raise public awareness has been evaluated with respect to their ability to engage with the public. Methods on how to improve attitudes to, and responsibility towards water conservation has also been investigated.
The Environment	This involved a study of how to improve the awareness of water issues in environmental terms of an overview of environmental concerns.
Industry	The industrial sector was investigated in terms of the awareness, attitudes and behaviours of its managers in relation to water management issues. In addition, the potential has been assessed for the private sector to work alongside other stakeholders in promoting good practices and better water awareness.

Following the analysis and discussion of the extensive surveys, successful models from the United Kingdom has been analysed with respect to their success in building public engagement and participation. Using the results of the UK campaigns as a model of how awareness and good practice can result in significant improvements in water conservation has been developed and discussed in chapter five in the light of how it may provide a model that can contribute to IUWM.

In chapters six and seven, paradigms of water conservation, recycling and environmental awareness has been compared in order to enable the formation of a new paradigm for an effective Integrated Urban Water Management system which will be tested against the major research question of this thesis. It will be shown how the new database that was presented and discussed in chapter four is essential for the operation of the proposed paradigm. Finally, the conclusion of the research has summarised its contribution to knowledge, and make suggestions for further research.

Chapter 2: Literature review

2.1 Water Management in the Kingdom of Saudi Arabia

This thesis began with a short account of the current Saudi situation with respect to how diminishing water resources must cope with an ever increasing demand. An analysis of this demand for water will follow, detailing how different social groups impact on water availability. The second section of this chapter will then provide a comprehensive overview of how this demand for water is currently managed in Saudi Arabia, with an assessment of current practices of integrated urban water management.

2.1.1 Water Demand in Saudi Arabia

In Saudi Arabia, there are several types of water uses which are mainly prioritised according to the Islamic Laws. They are as follows: domestic use, animal watering, agricultural use, industrial use and finally recreational use. Giansiracusa (2010) however points out that because renewable water resources are decreasing at an annual rate of 2%, the current level of consumption is unsustainable. Giansiracusa goes onto explain that in 2010, Saudi Arabia's renewable water capacity was only one quarter of the global average. The situation would worsen due to population increases that the World Bank forecasts will rise to 31.6 million in the next decade.

Giansiracusa goes on to explain efforts by the Saudi government to save water by reducing wheat production in addition to investing in desalination technology and discussing how to reduce subsidies. In the late twentieth century, a program to make the Kingdom self-sufficient in wheat had led to almost 85 % of water being used for agriculture. Now prepared to face the problems of non-sustainable water resources, the government aimed to phase down its agricultural subsidies in order to cut wheat production annually by 12.5% over an eight year span, so that by 2010, farmers had cut planted areas by 40% (Giansiracusa, 2010).

Figure 4 shows the overall growth in Industrial, domestic, and agricultural water demands in Saudi Arabia:

Source: Abderrahman, 2006

According to Gasson (2011-2012) director of the Sustainable Water Alliance for Severn Trent Services, the third largest consumer of water per capita in the world is Saudi Arabia, which is significant in view of its renewable water capacity being only 25% of the global average. A reversal of this trend is expected in the future, however as Saudi Arabia is expected to become the third largest water user of recycled market in the world, after the United States and China. Gasson however also points that only 18 % of the 1.84 million m³ of wastewater processed every day by the KSA, is reused at the present time.

Al-Zaharani, Al-Shayaa and Baig (2011) emphasised the urgency of developing conservation and managing the water demand in order to create a balance between need and availability. To paraphrase, focussing on the management of water demand instead of developing ways of increasing the supply should lead to a much improved use of resources. They also pointed out that efficiency can be improved among non-domestic users through developing technologies and education initiatives.

In Alriyadh newspaper, Alshibl (2012) stated that the rapid increase in urbanisation in the city of Arriyadh was leading to an increase in demand at the same time as reducing the availability of the water supply. A contributing factor was also the volatile weather in the capital, including sandstorms and dust clouds.

A few days later, by the Riyadh Business Unit Director in the National Water Company (Eng. Nimr Muhammad Alshibl), also in Alriyadh newspaper, Alshibl (2012) reported that Arriyadh (the capital city of KSA) had one of the highest rates of water consumption in the world. It confirmed the MOWE's estimate in that consumption could reach 330 cubic litres per person, where in the other capital cities, the average usages between 120 cubic litres and 220 cubic litres daily. The report continued with suggestions for domestic users to check for water wastage through leaks.

2.1.2 Identification and recommendations for water progress in Saudi Arabia

The following facts about the water sector are from the analysis paper *Water and National Strength in Saudi Arabia*, published in March 2011 by the Centre for Strategic and International Studies (CSIS) - Middle East Program:

The rapid development in the Saudi government and especially the water sector has been recognised by the international community. In 2001, the Ministry of Water and Electricity received four international awards for expert water management in an arid environment. Saudi Arabia accounts for about 30 % of global capacity. (figure 5) (CSIS, 2011)

Data from the analysis paper will be paraphrased and diagrams reproduced, in order to explain the more significant facts about current water usage in the Kingdom.

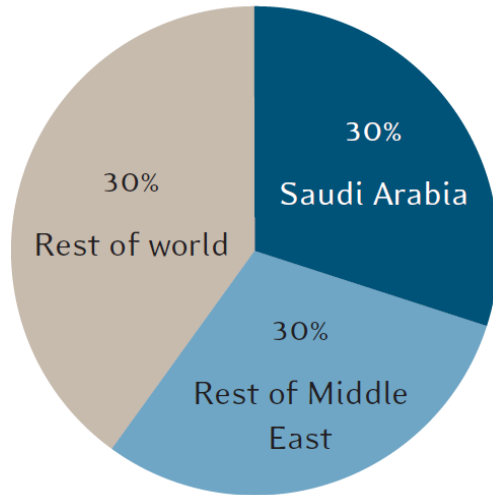


Figure 5: Global Desalination Capacity and the KSA, the percentages are given to the nearest 10%

The Kingdom of Saudi Arabia has twice the population of other Gulf Co-operation Council (GCC) countries, but the Government can provide around 50% more water per person than the average GCC region. By 2016, it is estimated that the wheat production will end in the KSA, making significant savings to the Kingdom's groundwater supply, but future agricultural policies will need to be carefully considered to meet the needs of users at the same time as conserving water supplies. Irrigation technologies could be developed and improved because at present 35% of Saudi farmland is currently irrigated via traditional surface or flood methods (see Figure 6), but the development of drip or sprinkler irrigation systems would yield a significant saving (CSIS 2011).

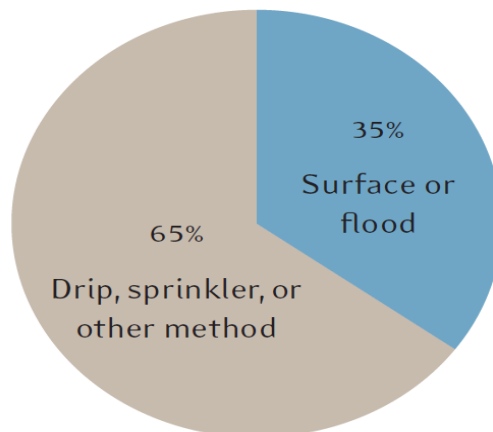


Figure 6: Irrigation methods in Saudi Arabia

Desalinated water accounts for between 50 percent and 90 percent of the use of a typical Saudi city, seen in Figure 7 below. However, it is currently a non-renewable resource requiring large quantities of energy through oil. At the moment the KSA can provide this, but in addition to the pollution issues from desalination plants, the use of oil is not a long term strategy as desalination already accounts for more than half of the kingdom's domestic oil consumption,

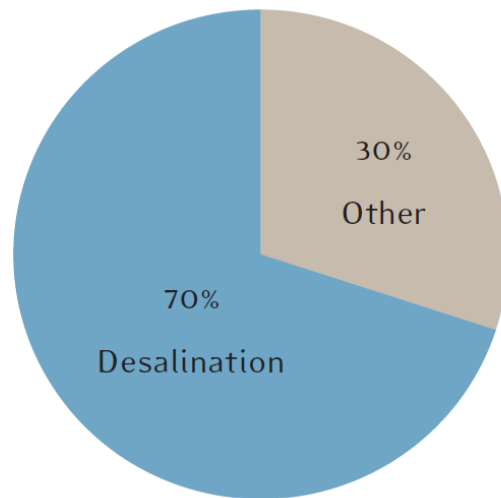


Figure 7: Sources of water in the average Saudi city

Significant savings could be made through an improvement of the infrastructure in order to collect, treat and reuse wastewater. This could be used for agriculture in order to relieve the demands on groundwater resources and reduce the use of desalinated water. Only 45 % however, of wastewater is actually collected, seen in Figure 8 and an even smaller fraction is treated and reused at present.

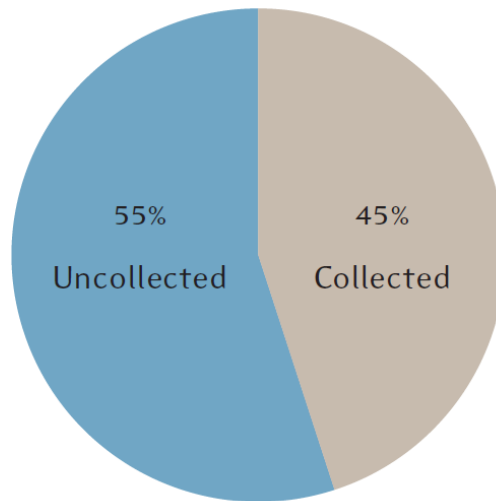


Figure 8: Saudi wastewater

With respect to the problematic issue of water pricing, consumers only pay about 1% of what it costs the government to provide water (CSIS, 2011). For the government to maintain current water provision in the face of ever increasing demands, it may need to consider raising tariffs or metering. In addition to the Kingdom investing in new technologies, metering would enable water use to be accurately tracked. Relevant data could then be stored for future reference.

This has been a summary of the facts and recommendations from *Water and National Strength in Saudi Arabia* (CSIS, 2011). A discussion of what is actually happening to address the status of integrated urban water management in Saudi Arabia has been presented in the following Section.

2.1.3 The status of Integrated Urban Water Management (IUWM) in Saudi Arabia

Cosgrove and Rijsberman (2014) in their book *Making Water Everybody's Business* have revealed that by 2025 about 4 billion people will live in countries with high water stress, including Saudi Arabia and all of the other Arabic countries. They also quoted these statistics for the ratio of human use to total renewable resources which show that water stress is affected by the availability and variability of water sources. Indicating a value of 40% to indicate high stress, it ranges from 20% for basins with highly variable runoff, to 60% for temperate zone basins.

The analytical paper *Water and National Strength in Saudi Arabia*, published in March 2011 by the Centre for Strategic and International Studies (CSIS) - Middle East Program has provided an overview of the current situation of the water sector in Saudi Arabia. Although the Kingdom is rich in oil but has scarce renewable water supplies, the government has nevertheless succeeded in satisfying water demand through investing in desalination and domestic agriculture. The authors point out that many governments around the world would struggle to fulfil these needs.

The paper also found that although the Saudi Government predicts that it will continue to cope with demand, there are several issues to address with respect to increasing water scarcity. It will be necessary to end wheat production by 2016 for example to ease the demand on groundwater resources.

Geographical issues are a major part of the Kingdom's problem according to Al-Zahrani and Baig (2011), who provide the following statistics of water use. The environment is arid and water resources limited, so as demand for fresh water increases, supplies will diminish until that they are no longer able to meet daily needs.

Al-Kahtani (2012) has analysed the most important factors that could contribute to a rationalisation of domestic water consumption in Saudi Arabia. His results and projections are paraphrased in this section. Up to 11% of water consumers can be influenced by water conservation campaigns organised by the Ministry of Water and Electricity, but more than half the population, 58%, are not yet influenced by campaigns. Al-Kahtani believes that a policy that encourages consumers to limit use is not sufficiently effective in the short term, though presumably such campaigns would be part of a longer term strategy. A new policy is required to rationalise water use as quickly as possible. Some commentators have turned to Integrated Urban Water Management as an effective approach, but IUWM cannot be considered a short-term approach in itself as it is a complex, longer term strategy. It could be argued however, that IUWM has the potential to enable strategies for immediate reduction in usage, combined with a longer term approach to change people's attitudes and behaviours to water.

Mays (2009) describes IUWM as a new approach to managing the entire urban water cycle in an integrated way, a key to achieving the sustainability of resources and services. IUWM incorporates all these factors: all water resources including surface and groundwater resources, the quality and quantity of water provision, the fact that water impacts upon other systems and finally the co-relation between water and social and economic development.

In the Special Feature on Integrated Urban Water Resources Management (IUWRM), prepared by the Water Team for the Global Development Research Centre (GDRC) website, IUWRM has been defined as:

A participatory planning and implementation process, based on sound science, which brings together stakeholders to determine how to meet society's long-term needs for water and coastal resources while maintaining essential ecological services and economic benefits. (GDRC, available at www.gdrc.org)

The IUWM/IUWRM approach has the potential to deal with all water issues including the supply and conservation of water. The question therefore arises: *What improvements could be achieved by applying the IUWM approach in the Kingdom of Saudi Arabia?*

Al-Hussayen Abdullah (2007) revealed a number of statistics in support of the need for IUWM, including the fact that only 45% of all wastewater produced is actually collected and only 6% of treated water is being used. Also about 70% of drinking water needs are produced by thirty water-desalination plants serving forty cities (as we have seen, desalination is the largest provider of water for domestic use). This makes Saudi Arabia the world's largest producer of desalinated water representing 30% of the global production.

If the KSA is to become less dependent upon desalination, water recycling which is currently so under-used, becomes one of the important components of IUWM as confirmed by the 'Bellagio Statement' through the members of the Water Supply and Sanitation Collaborative Council (WSSCC) during its 5th Global Forum in November 2000. The 'Bellagio' statement claims that an implementation of its principles would create an urban water system more reliant on recycling principles. In this way, waste water would also become as resource as in which

waste water is an integral part of a recyclable supply. Treating waste would lessen the risk of contamination but it could be argued that the technology would need to be developed, particularly with respect to the use of chemicals.

In 2009 the report from the U.S.A - Saudi Arabian Business Council for The Water Sector in the Kingdom of Saudi Arabia (2009), explained the history of Saudi water management since the 1950's as a move away from surface water towards a dependence on desalinated water. The report reiterates that the Kingdom of Saudi Arabia is the world's largest producer of desalinated water and the quarters of the Marafiq complex in Jubail is the world's largest independent water and power project. In addition, Saudi Arabia will have one of the largest water pipelines in the world. It is explained that a transport system of more than 900 km will pump about 4 million cubic meters of water per day Jubail Industrial City into Riyadh.

The report stresses how as water becomes an increasingly scarce resource, future water management will put increasing pressure on the water infrastructure, as factors such as industrialisation and urbanisation continue to come into play. However, it has been revealed that an average of 20% of water is lost because the twenty five year old infrastructures already under strain and prone to leaks. Furthermore, tariffs are extremely low, at a rate of only \$ 0.27 or SR 0.10 per cubic metre and the report recommends an increase in the tariff to as much as \$ 1.40 or SR 5.00 per cubic meter.

Abu Zeid Mohammed, Abu Zeid Khalid and Afifi (2005) draw attention to the fact that in the Arab world, The United Nations Development Programme (UNDP) is committed to support countries to achieve water-related targets from the World Summit on Sustainable Development (WSSD), in partnership with the Arab water Council (AWC) and the centre of Environment and Development for the Arab Region and Europe (CEDARE). In Saudi Arabia, the ministry of Water and Electricity governs the water sector. It is ensuring that the action plan for the water sector strategy is in compliance with the UNDP requirements. The process has been prepared with the assistance of the World Bank and UNDP, and has been separated into three stages. The first stage, an assessment of the then current water resources management was completed in

January 2004. The second stage is to develop water sector policies through extensive consultation and the third stage will be to develop an action plan for the implementation of this strategy. As this strategy will involve multiple partnerships and stakeholders, it will be an opportunity to implement integrated urban water management as a national strategy.

Zaharani, Al-Shayaa and Baig (2011) as discussed in section above, called for the emphasis of water management to concentrate on rationalising demand rather than increasing the supply. In this respect, they raised concerns about the amount of water currently wasted by domestic users. They claim that over-generous subsidies has led to the false impression that water is a free resource and that all stakeholders including the policy makers, planners and consumers need to reconsider their attitude to water as a matter of urgency. In addition to increasing demands from all users, Al-Zahrani and Baig arrive at the conclusion that the available water sources will be unable to meet the requirements of ever-increasing population of the Kingdom. This state of affairs has led to the need for the enhancement of the Integrated Urban Water Management in Saudi Arabia. At present however, water management systems are not sufficiently co-ordinated to enable IUWM, so the optimisation of available water resources will be delayed. (Al-Zahrani and Baig, 2011)

The concept of integrated urban water management is therefore a combining of sustainable water use with successful decision making processes. Marsalek, et al (2007) stated that 'effective management of urban water should be based on a scientific understanding of the impact of human activity on both the urban hydrological cycle – including its processes and interactions – and the environment itself. Such anthropogenic impacts, which vary broadly in time and space, need to be quantified with respect to local climate, urban development, cultural, environmental and religious practices, and other socio-economic factors'.

Marsalek, et al (2007) place human action in the centre of IUWM. In addition, the workbook for the Integrated Urban Water Management Approaches, prepared by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2007), defines integrated urban water management in this way:

'...although the use of individual tools clearly indicates positive steps towards its adoption, it does not mean that a utility is fully committed to IUWM. The IUWM approach requires not only the use of relevant IUWM tools, but also requires an understanding of the biophysical, social and economic implications of utilising these tools, taking suitable actions to mitigate any adverse effects and developing a highly coordinated and participatory approach to managing the water supply, wastewater and stormwater systems as a holistic system. Hence, one major change for IUWM is the engagement of all relevant agencies and the public in search of solutions that are effective in meeting sustainability objectives.'(CSIRO, 2007).

To achieve fair and effective water use, the role of extended education is of prime importance:

'Without creating awareness among the users and educating the general public on the importance of this precious resource, all conservation measures adopted would be limited. Once they are convinced of its wise use and become water conscious consumers, they will happily put all the suggested water conservation measures into their practice and implement the plans and policies with letters and spirits, offered by the Kingdom.'(Al-Zahrani and Baig, 2011).

Public engagement therefore is central, and of course there are barriers that would be overcome by a heightening of this awareness. Increased public awareness about and participation in IUWM will empower communities to decide on their level of access to safe water and will they will have a much better idea about how much water they will need for everyday life. It will also influence a sense of responsibility and ability to value water, whether it is fresh, or recycled. In addition, communications with the water authorities will be much more meaningful.

The 2009 report *The Water Technology Program: Strategic Priorities for Water Technology Program in KSA* has provided further important information about the water sector. It cites the King Abdulaziz City for Science and Technology (KACST) and The National Policy for Science and Technology which defined eleven programs for the localisation and development of strategic technologies deemed essential for the future development of the Kingdom of Saudi Arabia (KSA). The eleven programmes were approved by the Council of Ministers in July 2002 and including the Water Technology Program. The technological areas selected were those that best met the criteria and had the greatest potential for developing the scientific and technical capacity of the Kingdom, in addition to meeting urgent water needs:

- Water desalination: thermal desalination and hybrid desalination.

- Drinking water treatment: membrane treatment, chemical treatment, ionic exchange, disinfection and filtration.
- Wastewater treatment: biological treatment, biological membrane treatment, chemo-physical treatment and advanced treatment.
- Water resources management: water conservation, water re-use and recycling, groundwater recharge, rain harvest and cloud seeding.

The report also shows the SWOT Analysis (table two) for the Water Technology Program. This analysis demonstrates strengths, weaknesses, opportunities, and threats or hazards. In a SWOT analysis, strengths and weaknesses are defined as interior to the association whilst opportunities and threats are defined as exterior to the association. The association of this analysis is the water technologies program, including KACST, and other government organisations.

Table 2: The SWOT analysis

Helpful		Harmful
Internal	<p>Strengths:</p> <ul style="list-style-type: none"> • High national priority given to water-related issues. • Availability of local multi-discipline expertise • Availability of a viable national water industry 	<p>Weaknesses:</p> <ul style="list-style-type: none"> • Lack of experience with technology localization. • Low equipment and laboratory readiness. • Inadequate technical or human resources.
External	<p>Opportunities:</p> <ul style="list-style-type: none"> • Increasing need for water resources due to expanding population and industry. • Availability of energy at favourable prices. • Availability of vast shorelines. • Need for advanced technology to address remote areas water necessities. 	<p>Threats:</p> <ul style="list-style-type: none"> • Decreasing ground water levels. • High rate of technological change and obsolescence in the field. • Price and quality competition from international products.

Source: King Abdulaziz City for Science and Technology, the Water Technology Program, Strategic Priorities for Water Technology Program in KSA.

The weaknesses and threats listed by the SWOT Analysis illustrate some of the reasons why the application of IUWM has been piecemeal at best. In order for an effective strategy to be

formed, an accurate picture of factors including public awareness must be fully understood. Al-Zahrani and Baig (2011) stated that public awareness and participation was an essential component of IUWM. Commonwealth Scientific and Industrial Research Organisation (CSIRO) (2007) called for the full integration of all stakeholders.

However, until now an effective quantitative and qualitative analysis of data around these stakeholders has never been carried out. Public awareness has never yet been comprehensively measured and without this clear understanding of current awareness, strategies cannot be fully effective.

Critical review of the model

From the SWOT analysis of the model, it is evident that it faces a significant number of weaknesses and threats. This is despite having a number strengths and opportunities. The strengths of the model are important as they determine its success in terms of implementation. The identified strengths include high national priority being given to water-related issues, availability of local multi-discipline expertise and availability of a viable national water industry. Additionally, the model has a number of opportunities which also contribute and define the success of the model's implementation process. These opportunities include the increasing need for water resources due to expanding population and industry, availability of energy at favourable prices, availability of vast shorelines and the need for advanced technology to address remote areas water necessities. Thus, by maximally utilising the opportunities, the model can achieve the anticipated results. On the other hand, the success of this model may be challenged by the weaknesses associated with it. These weaknesses include the lack of experience with technology localisation, low equipment and laboratory readiness as well as inadequate technical or human resources. There are also threats that may hinder the exploitation of the full value of the model. These threats as identified are the decreasing ground water levels, high rate of technological change and obsolescence in the field as well as price and quality competition from international products.

However, there are a number of things that can be done to improve the model. One of these is equipping the personnel involved with the appropriate technology to allow for technology localisation. Also, adequate equipment should be purchased to ensure that the available equipment matches demand while also improving the readiness of the laboratory. The supply of enough technical and human resources should be considered to help in improving the model.

2.2 Integrated water resources management.

Water Awareness

The Department for Environment, Food and Rural Affairs (Defra) in the UK, has explained that the Water Awareness and Conservation include all the policies, strategies and activities made to sustainably manage the natural resource fresh water, to protect the water environment, and to meet the current and future human demand. Population, household size, and growth and affluence all affect how much water is used. Factors such as climate change have increased pressures on natural water resources especially in manufacturing and agricultural irrigation. (Defra is the government department responsible for environmental protection, food production and standards, agriculture, fisheries and rural communities in the United Kingdom of Great Britain and Northern Ireland: available at: <https://www.gov.uk/government/organisations/department-for-environment-food-rural-affairs>)

2.2.1 Theoretical approaches to integrated water management.

The Global Water Partnership defines integrated water resources management (IWRM) as:

A process, which promotes the coordinated development and management of water, land and related resources, in order to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. (GWP-TAC4, 2000).

The key emphasis in this definition is on a 'coordinated development'. Further clarification was provided in by Grigg (2008), In the study he defined IWRM as 'a framework for planning, organizing and operating water systems to unify and balance the relevant views and goals of stakeholders' (Grigg, 2008). This definition gives additional importance to stakeholders view and goals. The views and goals will vary depending on the specific cultural and socio-economic context of the environments being investigated. This research aims to identify the views and goals of specific stakeholders within Saudi society and how this influences IUWM.

An increased understanding of the role of the consumer begins to be a feature of these paradigms of water management as shown in Figure 9 which represents the movement from sub-sectoral to cross-sectoral water management as described by Grigg (2008); which links the

different sections through dialogue, but in practice there would need to be more information about how to systematically organise this dialogue, collect and analyse the relevant data. This research has addressed this issue by identifying how different stakeholders make up the different sectors. A database will then be established to enable a similar cross-sectoral dialogue.

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Source: GWP (2000) IWRM- At a Glance

IWRM seeks to manage the water resources in a comprehensive and holistic way, it has to consider the water resources from a number of different perspectives (Savenije and Van der Zaag, 2008; Ait-Kadi, 2014; Gao et al., 2014). Once these various perspectives have been considered, appropriate decisions and arrangements can be made. According to Savenije and Van der Zaag (2008) there are four perspectives of IWRM these are water resources, water users, spatial scales, and temporal scales and patterns. Central to most of the efforts over the last two decades is the concept of IWRM, which has been a nearly universal approach for reforming the water sector (Mostert, 2006; Funke et al., 2007; Hassing et al., 2009; Ait-Kadi, 2014). It is mainly geared towards achieving economically efficient, equitable, and sustainable use of water resources by all stakeholders (Van der Zaag, 2005). Most countries that have adopted the IWRM approach have been confronted with challenges (Gourbesville, 2008). These are mainly in the process of setting up the laws and regulations, implementing institutions, and management instruments and further following up in the process (Gourbesville, 2008). According to the Global Water Partnership, the IWRM model components are

summarised into a structure of three pillars that support the three principles and form a base for the balance between the main water uses. This balance can be seen in Figure 10, where the different partners or sectors were divided into management, the institutional or governmental framework and the enabling environment. The enabling environment is the pillar that would have an impact on the behaviour of people, but it is divided into policy and legislation. There is no specific mention of dialogue with the public and it can be argued that policy and legislation alone will be insufficient to change people's behaviours with respect to water usage.

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Figure 10: The three pillars of IWRM: an enabling environment, an institutional framework and management instruments (Hassing, 2009)

Van der Zaag (2005) took public and other stakeholders views and stated that integrated water resources management should take into consideration the following four dimensions due to the complex nature of water as a natural resource:

1. All water resources, taking the entire hydrological cycle into account
2. The water users, including all sectoral interests and stakeholders
3. The spatial scale, including the spatial distribution of water resources and the points at which water is being managed, for example individual users, user groups (e.g. user

boards), watersheds, catchments, (international) basin; and the institutions that enable this distribution.

4. The temporal scale; taking into account the temporal variation in availability of and demand for water resources, but also the physical structures are needed to match supply with demand.

Van der Zaag's arguments also differs in that it takes into account temporal and spatial aspects that account for some of the inconsistencies in water supply into consideration in the evaluation of IUWM. Again more attention has been made to the needs of the public as consumers, but no discussion of the form of dialogue that will be needed with respect to water usage and conservation.

These models have been largely theoretical with little indication of how they could be applied practically. Jeffrey and Gearey (2006) argued that IWRM has proved problematic during the transition from the theoretical (its policies and statements) to the practical (its tools and mechanisms) because of two main issues, which are:

- Nature of the science which has formed the background of the paradigm;
- The theoretical language, which they see as being more appropriate to philosophy or literature rather than engineering; in other words, the philosophical aspects of the language can seem at odds with the science of water distribution.

The International Water Association in cooperation with the United Nations Environment Programme (UNEP) prepared a report to identify six obstacles to the implementation of IWRM (UNEP, 2002 pp7-9). The report points to the difficulties in applying IWRM practically and argued the lack of reliable data that are essential for successful implementation of IUWM. The six issues include:

1. The lack of understanding and attention to the positive contribution that innovative workplace approaches can play in achieving IWRM objectives
2. The potential complexity of the IWRM concept

3. The need for reference projects
4. The lack of adequate skills, expertise and awareness
5. The lack of adequate and reliable data
6. Gaps in available knowledge and technology

McDonnell (2008) stated a similar problem with applying the theoretical approaches of IWRM. He argued that at present time the possibilities of a truly integrated water resources management are limited. This is not because they lack a conceptual framework, but because these concepts do not represent the complexities and variables that occur in any water management policy or project. The IWRM framework requires new methods. It is important that any proposed paradigm that aims to accomplish the ambitions of IWRM should take into account the work of academic researchers, environmentalists and social scientists in order to create a new approach to the methodology. Thus this research will include the views of a range of participants in order to enable the practical application of IUWM.

Integrated Water Resource Management programmes

There are some examples of IWRM programmes being practiced in different countries. The United Nations World Water Assessment Programme through the UNESCO identified which countries are currently applying IWRM and suggested how these processes can be evaluated. The following examples can illustrate some of the different examples of IWRM (Hassing, 2009). According to the United Nations World Water Assessment Programme, IWRM is a lengthy process. It can take many years to reach the point at which water resources management can finally be managed according to the most important principles of IWRM. In Spain, for example, the fulfilment of the process has taken nearly eighty years. This length of time is an example of one of the practical problems of IWRM (Hassing, 2009). Therefore this research propose that the process could be facilitated by better dialogue between the different stakeholders.

Other countries that are currently applying IWRM are the USA and Mexico. In the USA a conflict occurred as a source watershed in New York became polluted. The WWAP describe how this was eventually resolved at state level, leading to greater economic benefit. Secondly, in Mexico both decision-making and the organisation of tasks were decentralised. This approach,

following IWRM principles has led to significant improvements in irrigation at a national level. These examples show how the approach is similar to the three pillared approach Figure 10 in that management, institutions and local legislation worked together to improve the balance between supply and demand for water. IWRM therefore can work at a practical level as well as at a theoretical level. This research will aim to further investigate and resolve potential barriers to the practical application of IWRM (Hassing, 2009).

IWRM: Roadmapping towards the Millennium Development Goals and beyond.

On 16th March 2008, UN-Water in cooperation with the Global Water Partnership (GWP) announced the Roadmapping for Advancing Integrated Water Resources Management (IWRM) Processes. This was dependent on the Copenhagen Initiative on Water and Development at the Commission on Sustainable Development (CSD). The roadmap provided another approach to the practical problems of implementing IWRM (Roadmapping for Advancing Integrated Water Resource Management (IWRM) Processes, 2008).

The Copenhagen Initiative is an outcome of the International Conference on Managing Water Resources Towards 2015. It was hosted by the Danish Government in collaboration with UN-Water and the Global Water Partnership and held in Copenhagen on 13 April 2007 (Hassing, 2009). The Roadmapping Initiative aimed to support countries in their efforts to improve water management through an IWRM approach, and also to support the achievement of the seventh Millennium Development Goal which included adaptation to climate change. The initiative showed how changes in water can be organised into stages to support the achievement of the national goals through roadmaps. Figure 11 demonstrates some of these stages, showing both planning and implementation. In this regard, the Millennium Development Goals (MDGs) had finished, and they were eight goals for the year 2015 that had been established following the Millennium Summit of the United Nations in 2000.

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Figure 11: Stages in IWRM planning and implementation (Source: UN-Water & GWP initiative, 2008)

During this research, the Sustainable Development Goals (SDGs) began in September 2015, and they are officially known as "transforming our world: the 2030 Agenda for Sustainable Development". This is a set of seventeen aspirational "Global Goals" consisting of 169 targets and is spearheaded by the United Nations, through a deliberative process involving its 194 Member States, as well as global civil society. The goals are contained in paragraph 54 United Nations Resolution A/RES/70/1 of 25 September 2015. Available at:http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E#

Thus, this research can contribute to achieving certain goals for Saudi Arabia relating to the sixth sustainable development goal which is 'Clean Water and Sanitation – Ensure availability and sustainable management of water and sanitation for all'.

How effectively does IWRM map on to sustainable management?

The theories of IWRM will now be compared to methods of sustainable water resources management. Over time they have become global networks with widespread interconnections. These include Non-Governmental Organizations (NGOs), Intergovernmental Organisations

(IGOs), government departments, private foundations and think tanks, private companies, universities based on academic research and consultants.

These global networks are immediately accessible. A single website (e.g. <http://www.righttowater.org.uk>) has links to other websites operated by groups such as the World Water Council, the World Water Forum, the Global Water Partnership, the International Water Management Institute, the International Rivers Network, Water Aid UK, IUCN, and several UN agencies (for example World Bank, UNESCO, WHO). Each of these websites lead to many others and to a series of policy documents and scientific papers dedicated to the sustainable water resources management (SWRM) (Swatuk, 2005).

At the heart of this multiplicity of agencies however, is the conception of integrated water resources management (IWRM). IWRM is defined as:

'Equitable access and sustainable use of water resources for all stakeholders at regional catchment and overseas, whilst sustaining the features and integrity of water resources at the catchment range inside approved restrictions' (Pollard, 2002).

Loucks (2000, p.3), demonstrated that the sustainable management of water resources is a concept that emphasises the need to take account of the long term future as well as present needs. It is also a system of water resource management that is administered to meet the changing demands that can impact upon them in the future, without any degradation of the system. Such a system can be described as 'sustainable' according to the definition of sustainability as offered by the American Society for Civil Engineers): 'Sustainable water resource systems are those designed and managed to fully contribute to the objectives of society, now and in the future, while maintaining their ecological, environmental, and hydrological integrity' (ASCE, 1998).

IWRM principles therefore can be found in sustainable systems. This can go some way to answer the claims that IWRM is too theoretical. For example, Jeffrey and Gearey (2006) argued

that the goal of achieving 'sustainable' water resources management is best achieved through the Implementation of the IWRM strategies, which both encapsulate and apply all of the four Dublin Principles, which are :

1. Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment.
2. Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
3. Women play a central part in the provision, management and safeguarding of water.
4. Water has an economic value in all its competing uses and should be recognised as an economic good.

Points two and three are particularly relevant to IWRM strategies, where public participation is essential. This research will investigate and expand on these important points and add to the current knowledge by investigating possibilities of public awareness and participation.

Seven factors towards successful IWRM implementations

Having established that IWRM is suitable for practical application, Rahaman and Varis (2005) highlighted seven key approaches which should be adopted by water professionals to enable its implementation. These points are as follows:

- Privatization,
- Water as an economic good,
- Transboundary river basin management,
- Restoration and ecology,
- Fisheries and aquaculture,
- The need to learn from past IWRM experiences and
- The spiritual and cultural aspects of water.

In addition to being pragmatic, Rahaman and Varis' points also tailor the IWRM to meet different contexts during its implementation. Also, the World Bank is in agreement with this need for practicality, as this definition shows: 'The main management challenge is not a vision of

integrated water resources Management but a “pragmatic but principled” approach that respects principles of efficiency, equity and sustainability’ (World Bank, 2004).

The literature shows examples of how IWRM needs this range of integration through all levels of society. Allan and Rieu-Clark (2010) point out the need for governmental support, pointing out that accountability, participation and transparency appear to be the key elements of good governance of IWRM, although it is clear that these are not by themselves sufficient to support IWRM unless the governance regime addresses the access points between them (Allan and Rieu-Clark, 2010).

When IWRM is practiced in a way that includes all these different stakeholders, it has the potential to become what the World Water Council are aiming for in their discussion of water policy paradigms. They demonstrate that the IWRM approach employs participation; negotiation and dialogue in order to arrive at solutions that are beneficial to all parties.

Overall, there is a general opinion that IWRM has been proved as a flexible approach that can adapt water resources management into diverse cultural, social, political, economic or environmental contexts. However it will be necessary to propose a paradigm that will take into account all these theoretical, practical and participatory needs that have been discussed in the literature. This research explores the most effective methods to achieve this.

Marketing

A marketing approach is significant to water management as household consumers mainly in urban areas regularly obtain water from many alternative sources and providers. At some level, water utility companies are in competition with alternative water obtained from sources that are untreated. The alternative water supplies often substitute or supplement water that is provided directly by utility and are accessed through informal physical and human networks. Thus, it is clear that there is need to have an efficient and customer-focused marketing strategy in water management. As described by Hutt and Speh (2005) marketing management can be taken to imply the marketing mix concept. Marketing mix can be defined as a conceptual framework that

highlights the critical decisions made by marketing managers in configuring what they offer to the market to suit the needs of the customer (Hutt & Speh, 2005). Consumers have a continuous reaction towards their private desires as well as their external environment which serve as drivers of behaviour. According to Ivy (2008), there are 7Ps of the marketing mix. First, there is the product which is expected to provide value to the customers but may be intangible at the same time. Second, marketing mix involves pricing whereby it must entail profit and competitive as well. Third, there is the place where the consumers can purchase the product and the means by which the product reaches out to the area. Marketing mix also involves promotion which comprises of the many ways that communication to customers can be made regarding what is being offered to the market. Among the 7Ps is the people, which refers to employees, customers as well as the management and all stakeholders. Further, there is the process which relates to the processes and methods of providing a given service. Thus, it is fundamental to have an understanding of whether the product is of benefit to consumers, if it is made available on time and if customers are well informed about it. Additionally, there is the physical aspect which refers to the experience of using the service or product.

However, after the completion of the initial piloting work, there are reasons why water management needs to be reasonably comprehensive and strategic. One of these grounds is that there is the need for utilities to feel confident that if new services and opinions are to be offered, they can be provided on a basis that is reliable and sustainable. Also, equity and precedence should be taken into consideration implying that fair and rational targeting or new investments prioritising is required (Ivy, 2008). Successful water management, like any other business, seeks to meet customer satisfaction, increase market territory and hence maximise revenues. As such, it is vital to take care of the customers' attitude in order to achieve satisfaction. Constantinides (2006) states that marketing also involves investigating consumer behaviour in relation to a given product. This is because identification of the customer behaviour may play a significant role in satisfying the customers' requirements. According to Biswas (2004), consultation and collaboration with different stakeholders are critical to water management. Essentially, every individual plays a role in the fulfilment of the use and protection as well as sustainable water management. Some of the main benefits of consultations and

collaborations as highlighted by Biswas (2004) include strong relationships in terms of respect, trust, improved negotiation and information sharing among participants and stakeholders. Also, collaboration helps to increase the chances of success in the plan implementation due to the collective involvement of all stakeholders.

Integrated Urban Water Management (IUWM)

The critical literature review in this section discussed different ways in which Integrated Water Resources Management can have a practical, multi-agency application in addition to a theoretical aspect. This research will also explore ways to successfully integrate the different practical and theoretical approaches into a new proposed paradigm. Firstly however, moving on from IWRM, literature around integrated urban water management will be reviewed. The value of these models to this research will be also assessed.

Figure 12 illustrates the Urban Water Cycle. This water cycle is centred on practical human uses which include; storage facilities, irrigation, domestic and industrial use, treatment and return to waterways. It is a reflection of how the Water Cycle of evaporation and rainfall, cited at the very beginning. The urban water cycle is very important in this research because of focusing on the integrated water management in urban areas in KSA.

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Figure 12: The Urban Water Cycle: (Source: www.pacificwater.org)

2.2.2 The need for Integrated Urban Water Management

In the course of this literature review, different ways of looking at integrated water resources management were studied. It was agreed that although IWRM can be applied practically, an effective paradigm was lacking. Now, the possibility of including a specifically urban aspect will be assessed.

Bahri (2011) argues that the idea behind Integrated Urban Water Management (IUWM) is to address the entire urban water system as part of a coherent framework. Figure 13 describes some of the interrelated activities that IUWM brings together and will illustrate how this paradigm differs from Figures 9 and 10. Similar to the urban water cycle, Bahri's model takes into account human actions and places them at the centre of the diagram.

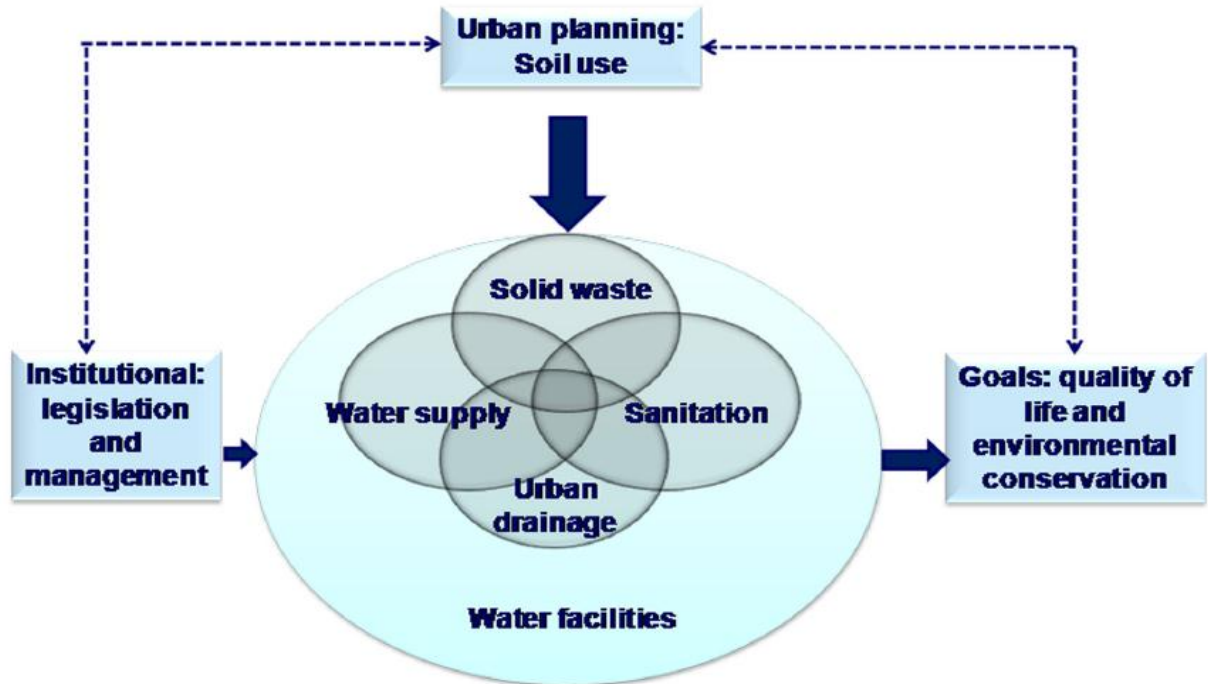


Figure 13: Integrated Urban Water Management (Source: Bahri, 2011, adopted from Tucci, 2009)

In addition to taking human actions into account, Bahri (2011) also states that the implementation of IUWM needs well managed institutions, with a range of public and private stakeholders who are in turn supported by a policy framework and appropriate legislation. The need for effective partnerships is becoming clearer.

A range of partnerships will also necessitate a range of activities. The United Nations Environment Programme (International Environmental Technology Centre) produced a brochure about IUWM, explaining it to be the practice of managing freshwater, wastewater, and storm water in addition to making links within the resource management structure and using an urban area as the unit of management. Activities under the IUWM umbrella are extensive and include the following:

- Improve water supply and consumption efficiency
- Ensure adequate water quality for drinking water as well as wastewater treatment through the use of Environmentally Sound Technologies (ESTs) and preventive management practices.

- Improve the economic efficiency of services to sustain operations and investments for water, wastewater, and storm water management.
 - Utilise alternative water sources, including rainwater, and reclaimed and treated water.
 - Engage communities to reflect their needs and knowledge for water management.
 - Establish and implement policies and strategies to facilitate the above activities.
 - Support capacity development of personnel and institutions that are engaged in IUWM.
- (UNEP, 2007)

Figure 14 groups different activities into five dimensions of the urban water system, which are seen as playing vital roles in providing urban water.



Figure 14: The mechanism of the urban water system

Source: Adapted from the Global Development Research Centre (GDRC)

Significantly, one of the five points of Figure 14 is ‘micro-action: what can we do?’; this micro-action will operate at the level of human actions, essential to integrated urban water management. The question however can only be answered by a range of appropriate data for the different urban locations, similar to that which will be undertaken by this thesis. The research will in turn provide the database that can form the basis for these micro-actions.

These micro-actions or local actions also play a part in what can be called the twin dilemmas for cities in their application of IUWM. As in Figure 13 they centre around human needs and human actions. Factors that create an imbalance between sanitation and the provision of clean water are shown in Figure 15.

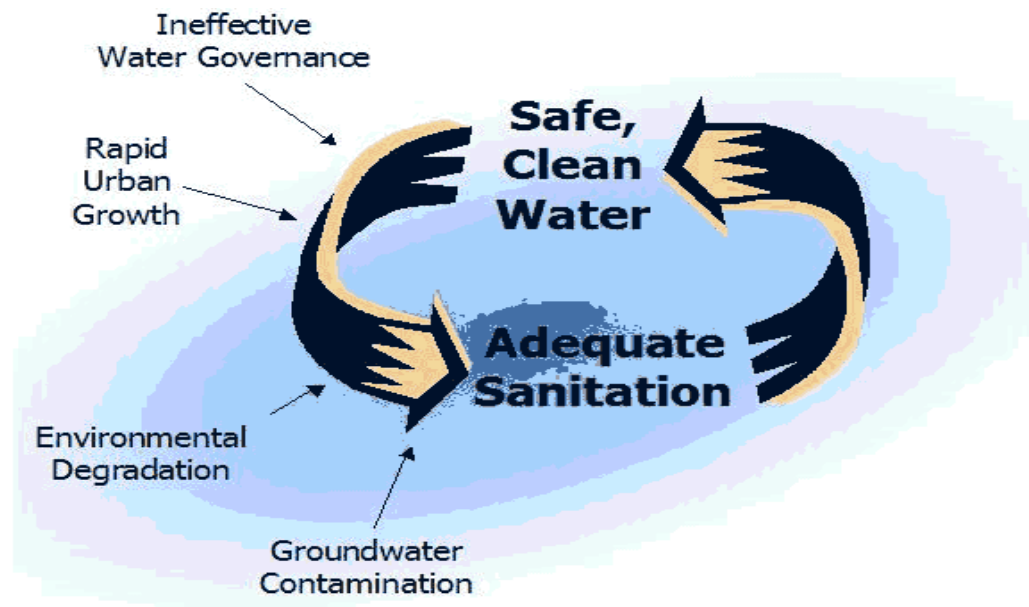


Figure 15: The Twin Dilemmas for Cities in IUWM Processes

Source: Adapted from the Global Development Research Centre (GDRC)

Mays (2009) also agrees that there is a need for a specifically urban aspect to integrated water management in *Urban Water management: Arid and Semi-arid (ASA) Regions*. They describe how the engagement of a range of stakeholders can go some way to resolve the dilemma of sanitation and water provision, through including a specifically urban aspect to water management. To paraphrase Mays, there is a strong opinion that IUWRM could be considered as an essential component of IWRM within the problematic context of urban areas. Stakeholder involvement for IUWRM should involve those responsible for water supply and sanitation services, storm water and solid waste management, regulating authorities, householders, industrialists, labourers, environmentalists, and recreation groups. Although local authorities are able to initiate and oversee IWRM/IUWRM programmes, planning and implementation should be led by a combination of top-down regulatory responsibility and bottom-up user needs.

However, top-heavy governmental approaches are to be discouraged due to bureaucracy and because it discourages dialogue with water users (Mays, 2009).

Because of the nature of the different stakeholders at this urban level, an effective dialogue must be set up so that water users develop a sense of responsibility for the provision of their water. This will be addressed in the course of this research as the need for public awareness and participation is debated and analysed.

What are the differences between IWRM and IUWRM/IUWM?

To summarise this section of the literature review, overall, the only difference between IWRM and IUWRM/IUWM is that the IWRM process is an overarching process that combines all relevant water issues and water management strategies, for both rural and urban areas including paradigms, programmes and plans into a pool of effective water governance. IUWRM/IUWM, on the other hand, is a specific sub-approach of IWRM approaches concerning water issues in urban areas. For the purposes of this research project, the social inclusion aspects that play a major role in the implementation of IUWM will be taken into account in the investigation of the public engagement in urban water management. It will now be necessary to look in more detail at these stakeholders.

2.2.3 Stakeholders and Public Participation

Public Participation

Rowe and Lynn (2005) defined Public Participation as:

A general definition of public participation with which few would argue is the practice of involving members of the public in the agenda setting, decision-making, and policy-forming activities of organizations/ institutions responsible for policy development. This definition enables the distinction of participation situations from nonparticipation situations associated with the more traditional model of governance in which elected policy makers, generally with the help of nominated experts, are left to set policy without further public reference (Rowe and Lynn, 2005, p.251-290).

Public Engagement

The National Co-ordinating Centre for Public Engagement (NCCPE) stated that “public engagement describes the myriad of ways in which the activity and benefits of higher education and research can be shared with the public. Engagement is by definition a two-way process, involving interaction and listening, with the goal of generating mutual benefit”. The NCCPE available at:<https://www.publicengagement.ac.uk/explore-it/what-public-engagement>

Castelletti and Soncini-Sessa (2006) defined stakeholders as those people, institutions and organisations that self-consciously react to decisions made on their behalf, while the decision maker is the individual that is responsible for making and implementing those decisions. A procedure that aims to make decisions on behalf of stakeholders is called informative participation. Before a decision is made on their behalf, they should become actively involved in the process, as if they were decision makers themselves.(Castelletti and Soncini-Sessa 2006). The important point is that the stakeholders must feel that they have some ownership over the decision making process. It goes some way to answering Mays’ concerns that governmental legislation alone will not be enough to promote IUWRM (Mays, 2009). This notion of dialogue and ownership will presently form the basis of a fundamental part of this research.

Castelletti and Soncini-Sessa further discuss the process of public participation confirming that all related issues should be voiced in order to achieve informed and creative decision-making. Where new views are presented, new approaches can begin and alternative decisions can be considered. Secondly, public participation enables social learning, where stakeholders and decision makers can interactively to manage and solve conflicting views and interests.

Similarly, Rahaman and Varis (2008) have revealed that the key issue in achieving efficient and effective water resources management is to initiate a management system where decision makers collaborate with the scientific community, water users, local communities and other stakeholders during a coordinated procedure. This challenge of working towards the active involvement of stakeholders in the management and development of water resources should be achieved via consultation, coordination and collaboration with social groups, private

enterprises, farmers, women and other water users. These writers agree that there is a particular need for public participation in efficient and effective water resources management.

Rahaman & Varis also discussed that in the case of urban water management, there should be recommendations to encourage public participation with local water organisations. This should help to optimise water use, protect water quality in urban areas and manage sanitation and water supply systems. In addition, Bell (2001) had stated that community involvement in IWRM or in other environmental issues is centred on three basic reasons:

- The emergence of a participatory approach demonstrates the importance of gaining the consent of local communities in taking part in public decision-making processes, especially on issues that directly affect their welfare. In this context, the participation of the local community could provide an important database of experience and ideas that could lead to practical, relevant, achievable and acceptable solutions to water related problems.
- The need to use indigenous knowledge as well as opinion is vital to environmental protection, including proper water resource use and management.
- The need to build public trust: Lack of public trust might lead to protest and antagonism between water resource users and other stakeholders due to varying interests and demands. (Bell, 2001)

In support of this, Dungumaroand Madulu (2002) state that:

The involvement of local communities in water projects does not only ensure democracy, but also ensures acceptability, support, and sustainability of the respective projects. The concept of bottom-up planning necessitates participatory approaches and involvement of local communities and other stakeholders from the grassroots level. This approach is the best option to IWRM because it ensures public trust, awareness and interest. (Dungumaroand Madulu,2002)

Bekbolotov, writing about water management in the Kyrgyz Republic has declared a similar definition in that the main objectives of public participation in integrated water resources management are:

- to ensure the use of the knowledge and experience of the public and other stakeholders in planning and management processes;
- guarantee identification of decision quality and adaptation to specific conditions;
- provide adequate planning and identification implementing decisions in practice;
- ensure consideration of public needs and priorities in the making of managerial decisions. (Bekbolotov, 2002)

Also Bekbolotov clarified the basic principles of the public participation in integrated water resource management as:

- active involvement of all the stakeholders and the general public, directly or indirectly;
- the process should be open and transparent, be conducted fairly and impartially, based on exchange of information, data and knowledge, using all appropriate information media; it is necessary to foresee certain conflicts and solve them;
- suitable mechanisms should be adapted to local conditions, to the problems and needs of all participants, focusing attention on reaching a consensus;
- participants should adopt a long-term vision on an acceptable condition of studied water body, watercourse or shore, recognising the differences in their interests, working together and learning from each other;
- this participation should not only consist in solving problems, it is necessary to provide opportunities for economic welfare and nature conservation, compatible with broader acceptable development objectives. (Bekbolotov, 2002)

There is a strong degree of consensus from these writers from different parts of the world. They have all demonstrated the need for a broad approach that will integrate both top down and bottom up planning through this attention to different stakeholders, particularly in an urban environment. Where this research will expand on these findings, is in the creation of a database that will encompass local knowledge and needs in the Kingdom of Saudi Arabia, therefore enabling effective planning from decision makers within institutions. These decision makers will be discussed in the section following.

2.2.4 Institutional Arrangements

Institutions are ‘the sets of rules or conventions that govern the process of decision making, the people that make and execute these decisions, and the edifices created to carry out the results’ (Gunderson et al., 1995). Cowie and Borrett (2005) have discussed that urban water management could be improved through a greater integration of ‘actors’ (or agents) and management institutions building a more interactive IUWM hierarchy as shown in Figure 16 below. This is a reciprocal and by implication productive dialogue between systems, managers and consumers, bringing about a transformation the familiar model of top-down management, where communication is necessarily central. The notion of a productive information exchange is also key to their conceptual model in Figure 16.

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Source: Cowie and Borrett, 2005

In the Figure 16 it can be seen that a manager can be differentiated on the basis of the resource streams of key concern. A manager may focus entirely on the supply of drinking water while another may solely be concerned with the management of storm-water and the receiving stream's assimilative capacity. Thus, each manager has their own activity domain which is determined by the resource streams of concern. The activity domain is also determined by the manager's decision making authority in relation to the resource streams as well as the inter-

relationships between the resource streams. Overlapping is possible for the activity domains and there is a variation in their sizes. Further, as depicted in the figure, interactions between various resource managers across the activity domain is facilitated by both formal and informal communication channels and cooperative arrangements. Of great importance is the information exchange that is depicted in the figure and which is considered as a key element of the conceptual model of IUWM. Information exchange plays a significant role in the development of positive public participation and awareness which ultimately enhances Integrated Urban Water Management.

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Source: Cowie and Borrett, 2005

As illustrated in Figure 17, in resource management and use, three distinct action levels can be identified namely collective, operational and constitutional. At the operational level, individual decisions affecting the physical world are made and are based on institutional arrangements as well as decisions made at the level of collective choice. However, constitutional choice

decisions are said to limit those made at the collective choice level (Cowie & Borrett, 2005). Though actions made at lower levels are bounded by those at higher levels, operational level actions are responsible for the direct effect on resources as well as the resource-use outcome distribution. Assessment and monitoring of information serves as a platform for providing feedback at the operational level regarding outcome distribution and the information can also provide feedback to the constitutional and collective choice levels (Cowie & Borrett, 2005). Therefore, assessment and monitoring provide feedback on the status of resource for operational actors' use when making production and appropriation decisions. The feedback provided in the levels of action is also promotes and encourages public and stakeholders' participation as well as their awareness which consequently enhances Integrates Urban Water Management.

It can be seen through these diagrams that institutional organisations within IUWRM systems are complex, but rely on productive dialogue. However, Cowie and Borrett's models are theoretical and do not suggest the means by which the groups of stakeholders can interact. A procedure that may go some way towards a practical integration of these different stakeholders will be discussed in the section following.

Participatory and Integrated Planning Procedure (PIP procedure)

One of the more suitable approaches to achieve the effective governance of (urban) water resources management is to follow the Participatory and Integrated Planning Procedure (PIP procedure). The PIP procedure is a methodology that consists of nine phases. They start by identifying the objectives of the planned actions and finish with a negotiation process between the stakeholders. This in turn will generate a set of alternatives or compromises that can be submitted to the decision makers as a final political decision (Castelletti, and Soncini-Sessa 2006). They explain that PIP is a recursive procedure as opposed to an algorithm, which indicates that people are continuously involved during the process. Decisions therefore must be taken at every stage on the basis of both subjective judgements and negotiations. Also PIP is a very versatile process, successfully used by many disciplines (e.g. Ecology, Hydrology, Sociology, Decision-making, Theory, and System Analysis). The following scheme, Figure 18, depicts the different steps of the PIP procedure:

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Source: Castelletti and Soncini-Sessa, 2006

Castelletti et al. (2008) defined the PIP procedure as a conceptual framework for the process development of decision-making when there are multiple objectives and multi decision makers. The PIP procedure has been designed to be as flexible as possible. In this way it can also

incorporate methods of quantitative and qualitative analysis in the different stages of decision-making (Castelletti, and Soncini-Sessa, 2006)

Each phase or step of the PIP procedure requires a 'toolbox' of ICT technologies which (because there are so many steps and so many possibilities) are integrated into a system, i.e. a Multi-Objective Decision Support System (MODSS). This would have implications were such a procedure to be used in the context of IUWRM, because suitable ICT systems would need to be put in place. It can be seen in Figure 18 how data joins both the planning and management sections, illustrating how this procedure is reflexive and discursive. Again, this underlines the need for comprehensive data at the basis of decision making processes, a need that this research has identified and analysed (to be discussed in a later section).

It is evident from Figure 18 that during the preliminary activities and objectives, the stakeholders must come to an agreement in order to proceed to the next step of the PIP procedure. For such an agreement to be reached the participation of all stakeholders is paramount. Further, in step two of the PIP procedure, the identification of actions involves the input of every stakeholder's suggestions and those by experts which are then considered. With every suggestion, the stakeholders are made more prone to collaboration as they feel that they are being taken seriously which is key to encouraging participation of all parties. Additionally, in the rest of the steps of the PIP procedure, the participation of stakeholders is a key element. This is evident in the design of the alternatives (step 4), estimate of the effects (step 5), evaluation of the alternatives (step 6), comparison and negotiation of the alternatives (step 7), mitigation and compensation (step 8) as well as in the political choice (step 9) whereby all the steps require the stakeholders' participation in order to reach a consensus. Therefore, the PIP procedure allows for the participation of stakeholders which raises their awareness and helps to develop Integrated Urban Water Management.

It is also worth considering Caterina Fonseca and Eveline Bolt's (2002) findings on water management in rural communities, as they can provide a microcosm of urban organisations. Their findings from 2002 are based on experience gained through a participatory research

project on the role of rural communities in the management of their water supplies. Fonseca and Bolt explained the role that managers need to play in identifying support requirements and in ensuring that this support is put in place.

Part 1 of the book of Fonseca and Bolt (2002) considers in detail two important trends in water supply and sanitation: decentralisation and the private sector. These trends are seen to have a major impact on community management and on the role of support agencies (decentralisation is defined as: 'the delegation of power from a central authority to regional and local authorities' (Merriam - *Webster Dictionary and Thesaurus*). The table 3 (below) describes such a decentralised framework. It is still very much a hierarchy, as the community are the lower level, but it represents how regional systems can operate through adapting a set of guidelines to their own particular needs. This is where communication between the different levels would be essential. A decentralised system could be relevant to IUWM because the different urban centres could organise their own systems.

Table 3: The division of responsibilities among national, district and community level

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Source: Fonseca and Bolt (2002)

Fonseca and Bolt (2002), in emphasising the role of privatisation in water management have brought another new element into play. The role of privatisation in integrated urban water resources management will be further discussed in a following chapter.

Having looked in detail at some of the significant literature about institutional partners, a discussion of other partners and stakeholders will follow. These partners will make up the discursive aspects of such a procedure as PIP and also encourage responsibility through decentralisation as suggested by Fonseca and Bolt (2002). The role that education has played will be investigated using some significant examples from the literature.

2.2.5 Educational arrangements

Campbell argued that 'environmental education is critical for the sustainable understanding, ownership and management of the water resource'. (Campbell et al, 2004). Apostolake and Jefferies also argue that ownership of resources is vital:

A range of storm water management practices are used in urban areas depending on several factors such as the availability of open and green spaces, the topography and geomorphology of the area and the perceptions of professionals and the public as to what forms the most appropriate storm water management practice for the local area. (Apostolaki and Jefferies, 2009).

Gallagher and Jefferies (2011) have discussed the importance of universities in providing research motivated by the needs of the stakeholders, that could feed back into urban water management. They believe that this, too, is an interactive process as the ideas for the research would come from the stakeholders. The universities should target research based training to professionals within the water sector, perhaps through e-learning, so an effective partnership could be built up, with universities becoming a stakeholder in this research based relationship. They provide a model, Figure 19, that illustrates an integrated approach to disseminating research outcomes among environmentalists which involved a close partnership between the different stakeholders (in this case) Sustainable Urban Drainage Systems (SUDS).

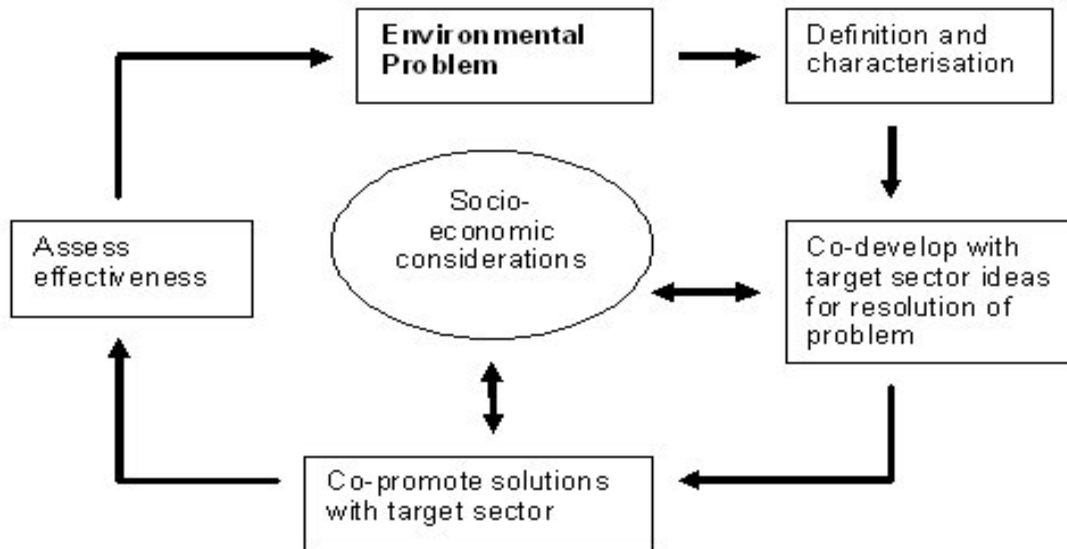


Figure 19: An Integrated Approach to Resolving Environmental Problems

Source: Gallagher and Jefferies, 2011; Adopted from D'Arcy & Harley, 2002

In another example of an integrated approach, Gilmour et al (2011) demonstrated the findings of a case study, in terms of the reciprocal relationship between public awareness and behavioural changes. The case study looked at ways of decreasing the environmental pollution from phosphates in domestic detergents and cleaning products which are flushed through urban drains. Findings indicated that there was considerable increase in awareness levels about pollution issues among the community as a consequence of the 2005/2006 Watersense campaign, but that this was not supported by changes in behaviours. It was argued that this was because the campaign had failed to address concerns about product performance and cost, concentrating instead on environmental issues.

The results of this review conducted five years after the campaign illustrated that knowledge and education can be a catalyst for changing behaviours but are not sufficiently adequate to embed these changes in the long term. Some important misconceptions had not been fully addressed, for example that products which are more eco-friendly are less efficient or very costly. This is in part due to a failure in the Watersense campaign to provide detailed information for consumers about the product itself. Instead, they concentrated on environmental benefit, i.e. theory instead of practicalities.

Education in the sense of imparting knowledge alone therefore, is unlikely to change behaviours in the long term. A sense of ownership of these initiatives is also required as is an agreed trust in any proposed changes. Troy W Hartley in 2006 had identified five principles that should underpin water resource planning initiatives. They are based around communication.

1. Manage information for all

Diverse types of information should be managed to promote learning, communication, and mutual understanding among all the stakeholders, given that people learn and communicate differently. This includes equal access to information, the use of multiple methods to present information and communication and supporting individuals in how they comprehend and process information.

2. Maintain individual motivation and demonstrate organisational commitment

People should find more good reasons (for example benefits for one's self and community) than bad reasons (for example real or perceived risks) to engage in public dialogue. Water resource managers should aim to ensure and also nurture multiple motives for the public to engage, highlighting both individual and community benefits. Organisations should demonstrate genuine commitment to engage and listen to the public and to take its concerns seriously.

3. Promote communication and public dialogue

Communication and the broader public dialogue should take multiple forms, including different venues and should be ongoing at all stages of a decision-making process. Water resource professionals should expect to have to repeat their messages multiple times (and in multiple ways) before it is truly understood by others. Likewise, people should expect to have to repeatedly listen to the messages of others (including in multiple methods of transmission) before they fully comprehend the information. In fact, the quality of public dialogue is an indicator of the public's confidence, trust and relationship with the water agency.

4. Ensure fair and sound decision-making and decisions

Both the decision-making process and the outcome should be perceived as fair and sound by all participants. Concepts of fairness include process, procedural dimensions and outcome, and distributive elements. Sound decisions are reasoned, well thought out and based upon accepted knowledge.

5. Build and maintain trust

A cumulative attention to the principles listed above contributes to the establishment and maintenance of public confidence and trust. It is advisable to maintain communication in order to work to build trust and credibility reserves with the public and to tap on those reserves when they are needed (for example to build communication channels with the media during times of non-crisis). (Hartley 2006, pp. 115-126)

To summarise, the five concepts in the framework present a strategy for building public confidence and trust through a strategic approach to public outreach, education, participation and planning.

It is through these principles that long lasting behaviour changes can be achieved. In figure 16 below, Nancarrow, Leviston, Po, Porter and Tucker (2008) formulated a diagram to illustrate how to facilitate change and address community concerns while encouraging a positive response in society.

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Source: Nancarrow, Leviston, Po, Porter and Tucker (2008)

Figure 20 illustrates that there are various tools that help in implementation of change. It is fundamental to consider the key factors that are likely to affect the support of decision-making agencies. Risk and trust are some of the major factors that the Six decision-making agencies should take into consideration. This is because, organisational trust or risk perceptions are actually receptive to change (Nancarrow et al., 2008). Trust has been highlighted as one of the key factors that facilitate change. Also, positive stakeholder or public participation cannot occur in the absence of trust indicating the vital role played by trust in enhancing Integrated Urban Water Management.

The complexity around using education and dialogue to instil behaviour changes and to encourage people to make different choices leads to scepticism about how effective such a programme can be. Gilmour and his colleagues believe that Triandis' theory overcomes many of the criticisms that are commonly made against rational choice theory. Rational choice theory supposes that clients make decisions through comparing the cost and benefit of the different courses of action and selecting the choice that provides the most predicted benefit. The theory

of Triandis is represented in figure 21 below, showing the multiplicity of factors that can influence behaviour.

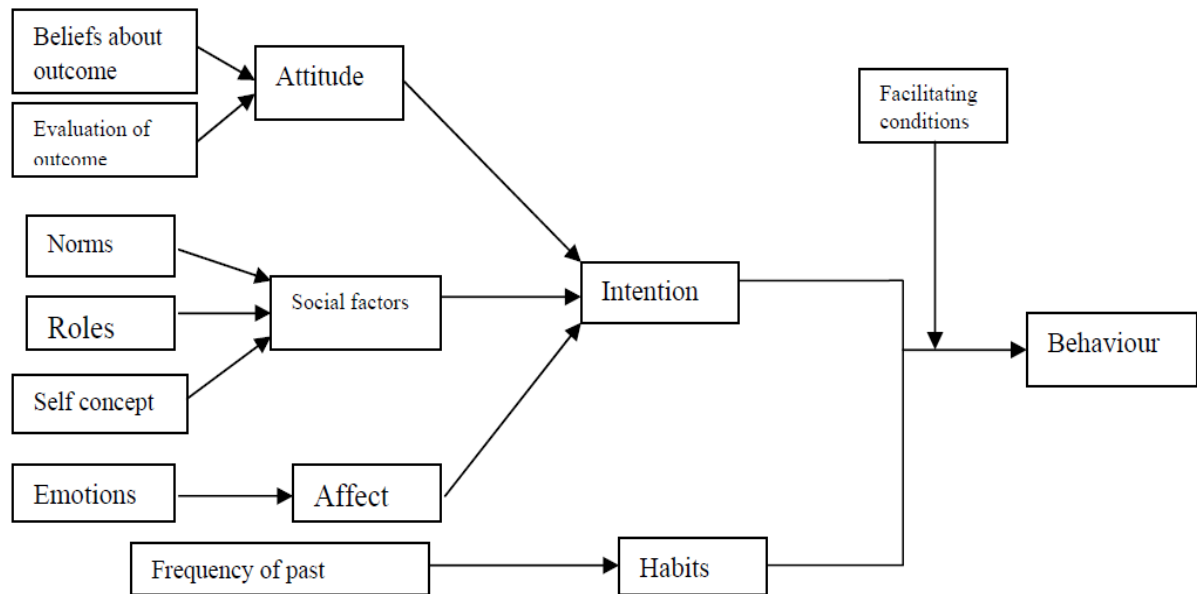


Figure 21: Triandis' Theory of Interpersonal behaviour

Source: Gilmour, et al (2011), Adapted from Egmond& Renee, 2007

It is evident from Figure 21 that behaviour can be described partly as a function of intention, partly of the habitual responses and partly of the situational constraints and conditions (Gilmour et al., 2011). Social and affective factors are considered to influence the intention in addition to moral beliefs. However, the impact of these factors is moderated by both cognitive limitations and emotional drives. The social factors include roles, self-concept and norms. While norms are social rules regarding what is right and wrong, roles are sets of behaviours that people consider proper for those holding certain positions in a group. On the other hand, self-concept is described as the idea that an individual has with regard to the appropriateness of the person to pursue the behaviours they or they do not engage in. In healthy collaboration and participation, there must be some norms that govern the participants' interaction as well as roles that each stakeholder should carry out. As such, the model depicted in Figure 21 gives the appropriate interpersonal behaviour model that could help engage people in maximum participation and hence enhancing Integrated Urban Water Management.

Poustie, Brown and Deletic (2011) under the title of *Receptivity to Sustainable Urban Water Management in the Pacific* have presented the results of an online questionnaire among urban water managers in the Pacific region. The survey measured receptivity levels toward the Water Sensitive City principles. Results confirmed that the participants were aware of the pressures of urban population growth and knew that pollution would increase stresses on the urban water sector in the next five to ten years. Despite this level of knowledge however, there was very little awareness of any sustainable solutions for those issues. Poustie, Brown and Deletic revealed that awareness of the problems in themselves will not be sufficient, they require a much more enhanced level of awareness to produce action.

Their solution is Receptivity Framework, which includes a range of factors that contribute to receptivity; categorised as awareness, association, acquisition and application. It is illustrated below.

Table 4: The components of receptivity framework

Component	Definitions	Example – SUWM in developing urban centres
Awareness	<ul style="list-style-type: none"> • Knowledge of a problem; • Knowledge of innovative solutions 	<ul style="list-style-type: none"> • Knowledge of urban waterway health degradation; and • Knowledge of innovative technical and non-technical solutions e.g. Stormwater treatment systems, wastewater treatment systems, water demand management techniques
Association	<ul style="list-style-type: none"> • Recognition of the benefit knowledge of solutions and options bring to the local context resulting in higher level support and commitment 	<ul style="list-style-type: none"> • Understanding that the urban water system is directly influencing the water quality of coastal water quality; • Knowledge that coastal water quality offers services to local residents and tourists; • Understanding that innovations may improved water quality and improved water management and water quality will have lasting financial benefits; • Resulting in high level political support, effective leadership, involvement of citizens and national level priorities.
Acquisition	<ul style="list-style-type: none"> • Ability to acquire the skills and knowledge to implement, operate and maintain innovations 	<ul style="list-style-type: none"> • Access of Government employees to professional networks for support and training; • Access to skills and capabilities through regional organizations (SOPAC, ADB)
Application	<ul style="list-style-type: none"> • Motivation and capacity to apply and implement solutions in the field 	<ul style="list-style-type: none"> • Knowledge of relevant legislation and policies relevant to urban water management; • Access to required funding programs (Government or aid based) for the implementation of urban water technologies or for establishing non-structural interventions

Source: Poustie, Brown and Deletic 2011, modified list for the Pacific Region from De Graaf et al 2009.

Table 5: Factors contributing to receptivity

Awareness	Acquisition
1. Organisation's knowledge of the local urban water system	11. Trust between partners and stakeholders
2. Other stakeholders' knowledge of the urban water system and management	12. Connection between water management and urban planning
3. Reliable scientific knowledge about the urban water system	13. Availability of networks and opportunities for stakeholder cooperation
4. Knowledge of innovative technologies available for urban water management	14. Quality of design skills in urban water management
5. Knowledge and understanding of urban water management legislation	15. Quality of negotiating skills in urban water projects
Association	Application
6. Enthusiasm of leaders in urban water management	16. Financial incentives and support from national government
7. Support and commitment from elected officials and politicians	17. Accountability of all stakeholders in urban water management
8. Involvement of citizens in urban water management	18. Commercial viability for private organisations
9. Organisational culture that promotes sustainable urban water management	19. Binding targets for water quantity and quality
10. Availability of an overarching national urban water	

Source: Poustie, Brown and Deletic (2011), modified list for the Pacific Region from De Graaf et al (2009).

2.2.6 Innovative approaches in urban water management

Jefferies and Duffy (2011) have presented the SWITCH Transition Manual as the conclusion of a major project. SWITCH (Sustainable Water Improves Tomorrow's Cities Health) was a research project funded under the EU FP6 programme, aimed at achieving more sustainable integrated urban water management in the 'City of the Future', thirty to fifty years from now. In order to face these challenges, SWITCH aimed to facilitate a paradigm shift in urban water management by converting previously reactive and ad-hoc actions into a coherent and consolidated approach.

The overall goal of SWITCH was to initiate change towards more sustainable urban water management. It can be argued that the new paradigm of SWITCH fulfils the requirements for the urban water systems of a city of the future (COF) or an EcoCity. Jefferies and Duffy stated: 'The overall approach is termed Integrated Urban Water Management(IUWM), which addresses the whole urban water cycle and delivers all-round benefits for society, the

environment and economies' (Jeffries and Duffy, 2011). This report is very significant in its presentation of a paradigm shift and will be further discussed at a later stage in this research.

Earlier, Van der Steen (2006) had explained how the approach to urban water management had developed over time. Both the Dublin Statement and the EU Water Framework Directive are cited as important stages. SWITCH initially builds on ideas from the 'Bellagio Statement', but also stresses the importance of a thorough and scientific 'sustainability assessment' of new approaches and new technologies in order to fully develop the SWITCH approach. Models and decision making support systems will be then used in order to evaluate (technological) innovations for IUWM under different future scenarios.

In order to fully appreciate the innovation of the SWITCH approach, some earlier work will be considered. Van der Steen (2006) explains that the 'Bellagio Statement' was formulated by the Environmental Sanitation Working Group of the WSSCC in 2000. He further maintains that its principles are essential for achieving the objective of worldwide access to safe environmental sanitation and a healthy urban water system as follows:

1. Human dignity, quality of life and environmental security should be at the centre of the new approach, which should be responsive and accountable to the needs and demands of the local setting. Solutions should be tailored to the full spectrum of social, economic, health and environmental concerns. The household and community environment should be protected and the economic opportunities of waste recovery and use should be harnessed.
2. In line with the principles of good governance, decision-making should involve the participation of all stakeholders, especially the consumers and providers of services. Decision-making at all levels should be based on informed choices. Incentives for provision and consumption of services and facilities should be consistent with the overall goal and the objective rights of consumers and providers should be balanced by responsibilities to the wider human community and environment.
3. Waste should be considered a resource and its management should be holistic. It should form part of integrated water resources, nutrient flows and waste management processes. Inputs should be reduced in order to promote efficiency and water and environmental security. Exports of waste should be minimised to promote efficiency and to reduce the spread of pollution. Wastewater should be recycled and included in the water budget.
4. The area in which environmental sanitation problems are to be resolved should be kept to the minimum size that is practicable, for example household, community, town, district, catchment, or city. Waste should be managed as close as possible to its source and diluted as little as possible. A minimal amount of water should be used to transport waste and additional technologies for waste sanitisation and reuse should be developed. (Van der Steen, 2000)

Also Van der Steen (2006) clarifies the sustainability concept for the urban water system as formulated by Lundin and Morisson (2002). They developed a Life Cycle Assessment (LCA) method Figure 22 to evaluate the environmental sustainability of urban water systems. Their system encompasses the entire urban water system including sludge disposal, materials consumption, energy consumption and agriculture. This recalls Bahri (Figure 13), who also stressed the importance of including the urban water cycle, because it takes into account human actions.

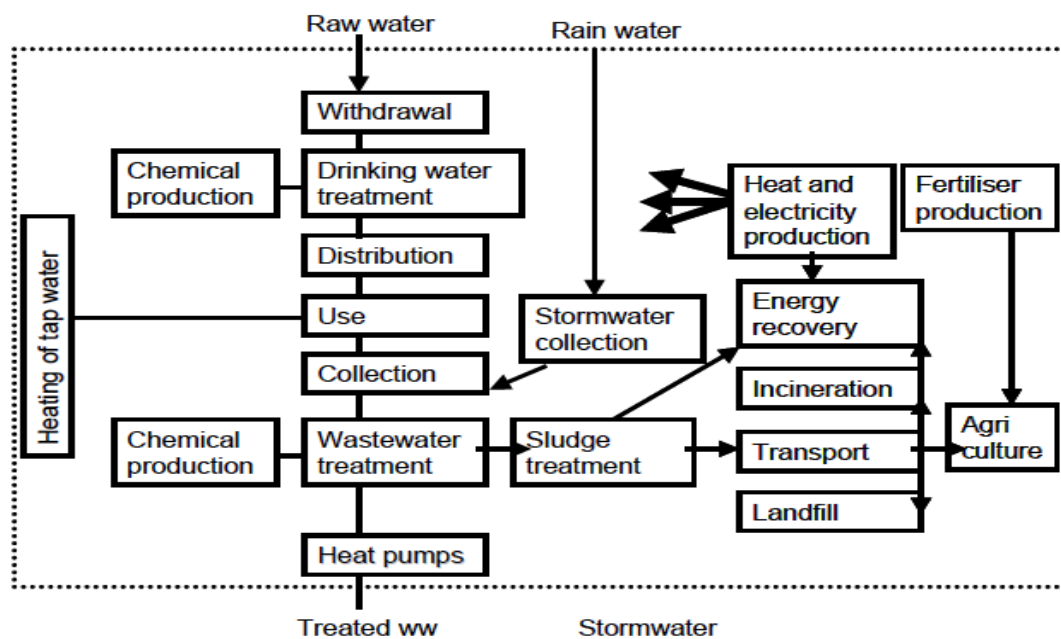


Figure 22: Urban Water system (LCA)

Source: Van der Steen (2006), adapted from Lundin and Morisson (2002)

The assessment of the sustainability of the LCA system is based on the stakeholders' identification of a set of 'sustainability indicators'. Scores from these indicators can then be utilised to decide on different water management options. A type of Multi Criteria Analysis then defines the best option, through giving weight to the different criteria and indicators. Models can then be used to complete the sustainability assessment of different options and to develop strategies for the planning of urban water management systems.

To enable a clearer and more comprehensive understanding of the complexities of urban water management, Howe et al (2011) have presented *Issues and Future Challenges in Urban Water*

Management from the findings of the SWITCH Project 2006-2011 in the diagram Figure 23

below:

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Source: Howe, et al (2011)

The Switch report and the Life Cycle Assessment demonstrate the real complexities of Integrated Urban Water Resources Management. The multiplicity of partnerships and the amount of data that will be required in order to make decisions are problems that the findings of this research will address, in order to propose a paradigm that is practicably applicable to the Kingdom of Saudi Arabia.

Identification of the gap in knowledge

From the literature review above, it is evident there is a gap in the knowledge about investigation of water awareness and public participation in IUWM in KSA. Therefore, this research aims to fill that gap from the water engineering and management perspective at institutional, educational, environmental, industrial and social levels. This research review is somewhat limited by variables and specific constraints, including the scope of the research (which is the interpretative analysis of the water awareness and public participation in IUWM in KSA), the selected sample of stakeholders, the genders of participants, and the positions of the stakeholders themselves.

The interpretative analysis of this research data presents significant new knowledge that can contribute to the implementation of IUWM in KSA. It will be argued that without this knowledge, a fully integrated policy of IUWM cannot be fully implemented.

Chapter 3: Research Design and Methodology

3.1 Introduction

This chapter will present the methodology of the research and explain how it has been applied through the course of the project. This research is first and foremost an engineering project that aims to investigate ways in which integrated water management can take public participation into account. For this reason, the methodology needs to take into account aspects from what can be broadly described as a survey research. The research, being based in the UK, sought as part of its originality to take a UK perspective to identify opportunities for transferring learning from UK experiences to the Saudi situation.

Various researchers have used different research methodology to carry out their studies. For instance, in a study on “Integrated Water Resources Management” Rahaman (2009) mainly uses review and comparative analysis of the outcome, action plan, recommendations and declarations of the major international water events and policy tools (Rhaman, 2009). Also, the researcher makes use of both primary and secondary data sources. The primary data and information was collected from appropriate experts and organisations, and also included the analysis of water related bilateral agreements between various countries. On the other hand, secondary data was collected from local, governmental and international organisations as well as other published articles, journal, documents, reports, books. Another research by Muthuwatta (2014), titled “Integrated Water Resources Modelling and Remote Sensing in Karkheh River”, mainly uses secondary data from relevant authorities and organisations. Muthuwatta (2014) also makes use of data available in meteorological stations as a source of secondary data. In Anwar`s work (2010), “Potentials for Water Conservation in Dhaka City”, surveys have been used to collect data. In the study, questionnaire surveys and discussions were held with residents of Dhaka city. Similarly, Kathryn Gold (2008), in “Water Conservation in the Regional Municipality of Waterloo, Ontario, and the Proposed Pipeline” also made use of questionnaires to collect data for the study. Further, the study utilised other two methods of data collection in addition to administration of questionnaires. The research also used the

analysis of newspaper articles as well as expert interviews with academics who have a close connection with the subject and related officials.

This thesis is about studying people's trends, perceptions and practices in applying the IUWM practicalities in KSA and the nature of this research depends on a questionnaire to investigate the public water awareness. *Survey research* as a methodology offers a variety of approaches that may be adopted during the research journey. There is a need to achieve a balance between 'data' and 'theory' and between empirical knowledge (obtained through observation and experiment) and theoretical knowledge and analysis. The target of survey research is to combine theoretical and empirical knowledge so that social phenomena can be accounted for, in a method that links theories about the social world to visible experience of it. (Harvey et al 2000). In general all research has a variety of purposes including:

- Developing theory;
- Informing policy;
- Providing further insight or elaboration;
- Raising awareness;
- Evaluating processes.

In accordance with these purposes, the research aims to utilise social research to better inform water resources management and to raise awareness of IUWM in order to enable the positive participation of the public as stakeholders. Thus the practicalities of this research require social theories.

In this regard, Elliott (2009) has explained the five key themes in contemporary social theory as follows. Firstly, the relation between the individual and society, or between human action and social structure; secondly, the degree of consensus or conflict in modern societies concerning the dominant values or norms; thirdly, change or social transformation that come about through the impact of globalisation, new information technologies and other factors. There is also a fourth theme that concerns gender issues where there are still inequalities between men and women in some of the social, political, psychological and cultural cases. A

final theme examines social and the emotional relations in our public and private worlds. The broad extent of these themes will impact upon a number of different concepts.

Ideology, Ontology, Epistemology, Axiology and Methodology

Universally, there are different concepts and views about how research must be performed depending on research philosophy: ideology, ontology, epistemology, axiology and methodology. The encompassing nature of social research will require attention to these concepts.

Ideology: The conceptual framework that formalises the cognitive map of the topic of a project also encompasses the motivation for carrying out the research. It can be differentiated in terms of whether the ideology of the research is qualitative or quantitative. The conceptual framework works to position the researcher in relation to the research as a whole and to position the ideological aspect inherent in qualitative research. (Holliday, 2007).

Figure 24 below, illustrates how the conceptual framework comprises an alignment of the key elements of the research project and ideologically positions its methodological approach.

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Figure 24: Positioning the researcher – a conceptual framework (Source: Holliday A., (2007))

Qualitative research agrees that research is ideologically driven where there is no value-free or bias-free design. The qualitative researcher early on defines his or her bias or viewpoint and

accordingly articulates the ideology or conceptual framework for the research. 'By means of defining one's biases, one can see simply where the questions that direct the research have been crafted'. (Janesick, 2000)

Ontology: Ontology is a term that is used to describe the study of 'being'. In order to study the social world, theoretical assumptions are made about the nature of society and the nature of people within it. These are sometimes termed ontological assumptions. In sociology, ontological assumptions can be more simply described as the ways in which we choose to define our subject matter (de Gialdino, 2009).

Epistemology: Seale (1998) has defined Epistemology as a specific theory of knowledge or, in the words of Williams and May (1996, p. 5), an answer to the question of 'where do we obtain our knowledge and how reliable is it?' It is apparent that Ontology and Epistemology are two key concepts that merge between research philosophy and methodology.

Axiology: is a branch of philosophy that investigates judgements about values. 'Though this may contain values we possess in the fields of aesthetics and ethics, it is the process of social query that concerns us. The role played by values in all strategies of the research process is of great importance for achieving credible research results.' (Saunders, Lewis, and Thornhill, 2007). An exciting idea from Herson's (1996) argument about axiology is the possibility of writing statements of personal values relative to the topic of study.

Methodology: Harvey, et al (2000) have distinguished between methodology and method in that the methodology involves specifying not just how the researcher plans to collect evidence, but why. Also it involves questioning the relationship between the methods used to collate evidence and the explanation, interpretation or understanding that is required. In brief, it is about the researcher's entire approach to an area of research while the methods are the instruments for collecting data.

There are two well-known approaches of social research, termed: quantitative social research and qualitative social research. On the other hand, Potter (1996) reported that there are seven predominant qualitative methodologies are: ethnography, reception studies, ecological psychology, symbolic interactionism, cultural studies, and textual analysis. In addition, Robson (2011) has pointed out that the research traditions in qualitative research approaches are mainly in the following list: case studies, ethnographic studies, grounded theory studies, others including narrative research, biographical and life history research, phenomenological research and hermeneutics. He has also stated that the quantitative research paradigm has been traditionally, directly associated with positivism, and clarified that followers of the quantitative research tradition in social research are categorised into two main ideologies: those who carry on the old positivist path, and post-positivists.

A case study strategy was defined by Robson (2002 pp 178) as 'a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence' The case study approach will provide the researcher with both qualitative and quantitative data using experimentation and coding schemes. With the intention of clarifying the qualitative research methodology, Cassell and Symon (1994) have observed that qualitative research can contain a number of defining characteristics which include a focus on interpretation rather than quantification, an emphasis on subjectivity rather than objectivity, flexibility in the process of conducting research, an orientation towards process rather than outcome, a concern with context (regarding behavior and situation as inextricably linked in forming experience) and finally, an explicit recognition of the impact of the research process on the research situation. Saunders, et al (2007) in the following Figure 25 designed the research onion as a way of depicting the issues informing the choice of how data is collected, including the time horizons, the research choices, the research strategies, the research approaches, and the research philosophies.

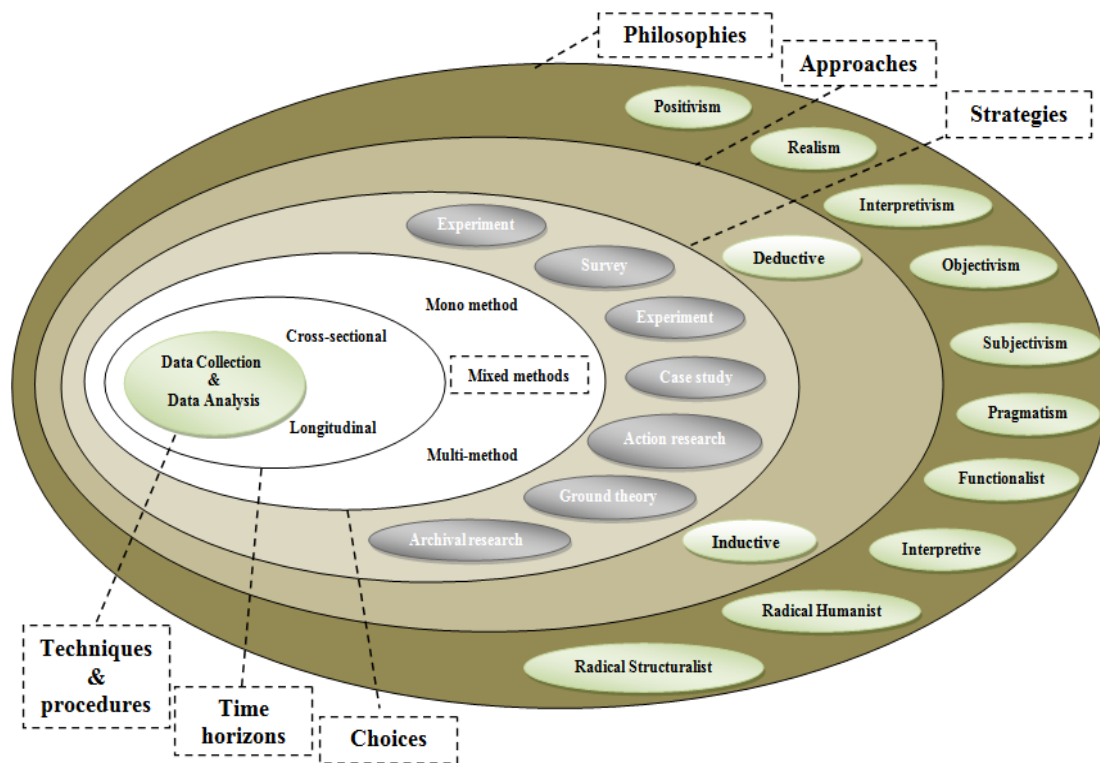


Figure 25: The Research Onion Source: Adapted from (Saunders et. al, 2007)

Gilbert (2008) has defined the inductive approach and the deductive approach. The two approaches of the philosophical paradigms are as follows. The inductive approach is the process of identifying a single case and investigating a relationship, therefore identifying similar relationships in several additional cases. Later, an over-arching conclusion represents the whole case. The deductive approach on the other hand is the process that begins with a theory and utilises it to explain a particular observation. Denscombe (2003) has categorised the strategies for social research into surveys, case studies, internet research experiments, action research, ethnography, phenomenology, and grounded theory.

Following these definitions, this thesis is an inductive research project and that both qualitative and quantitative research methodologies will be employed. These methods are appropriate with which to engage with practices, feelings and perceptions of water fields, from a range of stakeholders, including water policy makers, professionals and managers, environmental managers, technical practitioners and engineers, industrial managers, lecturers and academic and schools teachers, and from the general public in KSA.

The philosophy of the research methodology

The importance of the philosophy of the research methodology centres on the extent to which it influences the process of the research, from the research questions to the data collection and the dissemination of results, as illustrated in the following Figure 26.

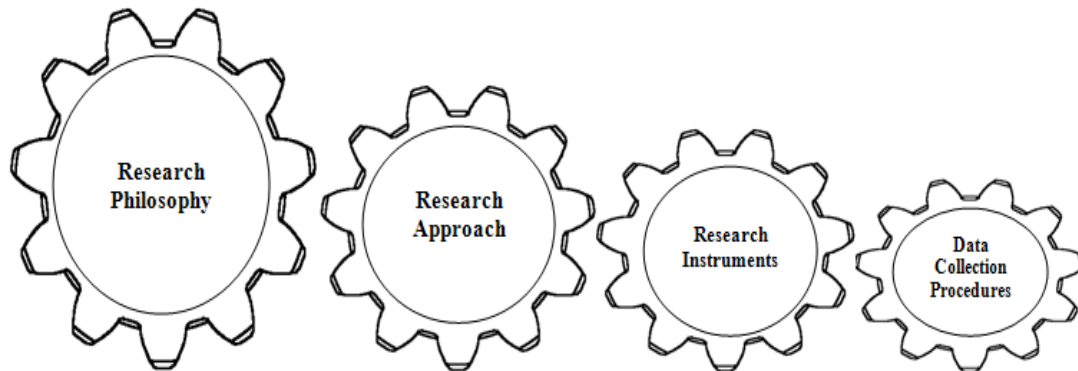


Figure 26: The importance of the research philosophy in driving the research methodology process

(Source: Author)

From the research objectives, the subsequent findings in the literature review and from the nature of the current state of water management in the Kingdom, it can be argued that there is an essential need to investigate the social and institutional effects on the current method of water management and how to employ integrated urban water management principles effectively.

Following the survey strategy/methodology, it will be appropriate to concentrate on the stakeholders, in particular the public participation and awareness about the IUWM, under the umbrella of IWRM dimensions, in order to address challenges. Hence, through stakeholders, the study will aim to investigate the success level of positive social participation in current water resources management from different perspectives, namely what are the appropriate forms of positive participation that can address which current urban water management challenges?

The level of social participation in enhancing the IUWM cannot be measured in financial terms. Instead, communications between the water authorities and stakeholders must be measured.

In this research the stakeholders will be divided into three groups: the public (participants/customers/consumers), teachers and lecturers (in the schools and in higher education), water policy makers/water managers (in the water authorities), and technical practitioners (water engineers/experts in the private-public partnerships).

Priorities and relevant issues

The study has identified the priorities that can be adapted to contribute in achieving both the sixth sustainable development goal where Saudi Arabia is one of the nations that endorsed the Sustainable Development Goals (SDGs), and those of the World Summit for Sustainable Development (WSSD, 2002) about access to water resources. Also the research will attempt to find the priorities that take into account the relevant outcomes of the Rio + 20 Conference. In doing so, the outcome of this research should enhance the application of integrated urban water management in the Kingdom of Saudi Arabia. Moreover, this research endeavours to advance IUWM practices and applications through improved stakeholders/public participation and an increase in public awareness.

Philosophical approaches/paradigms

Burrell and Morgan (1979) have clarified four categorisations of social science paradigms which can be utilised in water management. Figure 27 shows these four paradigms: functionalist, interpretive, radical humanist and radical structuralist. It also illustrates how the four paradigms are organised into four conceptual dimensions: radical change, regulation, subjectivist, and objectivist.

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Source: Developed by Saunders, et. al, (2007:112) from Burrell and Morgan (1979:22)

In relation to the purpose of this research, the interpretive paradigm is capable of guiding this project to be subjectivist in determining current practice and awareness; and in regulating operations to enhance awareness and positive public participation, in order to investigate how to establish IUWM through the public sector.

Moreover, in contemporary social research theories, there are three key global philosophical paradigms: the scientific paradigm, the critical paradigm, and the interpretative paradigm. These will be discussed in the paragraphs following.

The scientific paradigm

Cassell and Symon (1994) have clarified the assumption behind the positivist paradigm. They state that there is an objective truth existing in the world that can be obtained via a scientific approach, where the emphasis is on meaningful relationships among variables, both scientifically and statistically. Hacking refers to six positivist instincts that can be identified as following:

- 1- Emphasize verification (or in some cases falsification)
- 2- Pro-observation in comparison with other means of justifying scientific claims
- 3- Anti-case
- 4- Downplay explanations

- 5- Anti-theoretical entities
- 6- Against metaphysics(Hacking, 1983, pp. 41-42)

The critical paradigm

Critical Social Research (CSR) is a term encompassing approaches to sociological enquiry that endeavours to identify prior issues through questioning generally accepted views of the social world (Harvey and MacDonald, 1993).

The Interpretative paradigm

Schmalhofer, Strube and Wetter (1992) have revealed that in relation to social science and working with qualitative methods, the main idea of the interpretative paradigm is that human behaviour is not determined through established social or cultural norms (as associated with the normative paradigm). Every social activity or reaction of an individual is based on specific interpretative processes. People attribute a special meaning to situations and their events and outcomes are based on this particular meaning. Therefore, in order to understand such events, the researcher must understand people's interpretation.

Victoria (1987) further discusses the interpretative paradigm as linked to phenomenology, where research attempts to better understand the perspectives of all individuals engaged in an interface of situations, since it perceives reality as socially constructed rather than taking the positivists' objective position. It is influenced by the historical–hermeneutic sciences rather than the empirical-analytic sciences, and naturalistic inquiry is compatible with this critical stance. Moreover, the enquiry of the interpretative paradigm is finalised when an improved understanding of the reality is achieved.

Having considered these different paradigms, the key philosophical approach of this research will be the Interpretative paradigm, which will guide the methodological framework of the research. The rational and logical reasons for this selection are due to the suitability of this philosophical paradigm for the case study strategy adopted by this research, concerning as it does, a range of social groups and their relationship to the practice of IUWRM. It therefore follows that the strategy will be an interpretative case study because, as Burrell and Morgan

have stated, 'the social world is essentially relativistic and can only be understood from the point of view of individuals who are directly involved in the activities which are to be studied' (Burrell and Morgan 1979, p. 5).

Instrumentation (Research Methods)

Creswell (2008) stated that the best method to guarantee the reduction of research measurement errors is first to select 'a good research instrument' (Creswell 2008). Denscombe (2003) has classified the methods of social research into questionnaires, interviews, observation, and documents. Harding (1987) argues that all methods of evidence collating techniques within social science fall into three categories: listening to or questioning informants, observing behaviour and finally examining historical traces or records. From these suggestions, this thesis will adopt the most suitable empirical techniques to collect appropriate data.

Social Science Research Survey

The Le Sphinx Development handbook (2006) categorized the following four main topics that can be applied to a survey for any type of population. The fourth theme concerns only human populations:

- **Identity:** Who do you question? What objects will you observe?
- **Behaviour:** What are the respondents doing, how do they act? What are the characteristics of the observed objects?
- **Pressure motives:** What reasons influence their behaviour, explain their actions? What restrictions are the studied objects under?
- **Opinions and values:** What importance do the participants give to their behaviour? What values.

The handbook, shown in table 5 shows the different types of surveys and their particular advantages and disadvantages. This research will use the methods most suitable for its qualitative and quantitative methodologies.

Table 5: The different types of surveys and their particular advantages and disadvantages

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Source: Le Sphinx Développement (2006)

Selection of the Research Method

From this review, it can be seen that both interviews (with the UK water managers) and questionnaires with the respondents in the KSA (the three groups of stakeholders) will be most effective as the instruments for data collection, because this method will allow for a number of different perspectives to be expressed, in order to gain a broader understanding of the demographic. For the three groups of stakeholders in the KSA, written questionnaires were used due to the large sample of participants involved; as 220 people took part in total. For the five water companies/managers in the UK, face-to-face interviews were used to collect data as the respondents would have questions of their own with respect to the Saudi situation and the researcher would be present to respond to them.

There are various models for research interviews and the most efficient means of selection is through assessing its function in the overall framework of the enquiry. In the standardised, or

structured interview, the questions and the order in which they are asked, remain the same from one interview to another. In addition, interviewer's questions that form the 'interview schedule' remain the same. This notion of the 'schedule' expresses the formality of this type of interview. The next type of interview is termed semi-standardised, in which the interviewer enquires certain key questions that remain the same for each respondent, but in this case the interviewer is free to alter their sequence and to probe for more information if necessary. The final typology is the non-standardised interview, also called an unstructured or focus interview. In this case, interviewers have a list of themes which they want the respondents to discuss, but are free to suggest the questions as they wish and to ask them in any order that seems appropriate at the time. The interviewer can also contribute to the conversation by discussing their own opinions of the themes. The interviewer is always present with an 'interview guide'; where the term 'guide' conveys a sense of the style required by each case (Smith, 1972; Gilbert, 2008).

Qualitative Methods of Analysis

Potter (1996) has listed twenty methods of analysing qualitative data within a template of four groupings. This illustrates the range and the depth of possibilities of qualitative analysis.

1. Orienting Methods; Semiotics/semiology, Discourse analysis, Narrative analysis, Genre analysis, Dialogic analysis, and Historical analysis.
2. Construction Methods: Deductive; Marxist analysis, Feminist analysis, Psychoanalytical analysis, Postmodern analysis, Myth analysis and Hypothesis testing.
3. Construction Methods: Inductive, Grounded theory, Triangulation, Maximizing comparisons, Sensitized concepts and Thick description.
4. Other Methods of Construction: Analytical induction, Negative case analysis, and Retroduction.

Auerbach and Silverstein (2003) have shown how to develop grounded theory from the interview transcripts, using a procedure called coding; explaining that the term coding can be misleading; it suggests a routine mechanical process, whereas developing theory is anything but mechanical. However, because the term coding is firmly established in the grounded theory literature, they have used it as well. Also they have give their working definition on the question of 'What exactly is a theory?' is straightforward: A theory is a description of a pattern that you find in the data.

In addition Auerbach and his colleague illustrated the basic ideas of coding by saying, when you begin any project; you will probably fluctuate between feeling that you must include everything in your data analysis and fearing that nothing really is directly relevant to your research concerns. We characterize this stage as “finding yourself adrift in a sea of data.” Less metaphorically, you will experience a gap between your research concerns and your data, that is, the interview transcripts, as depicted in diagram below. The rectangle at the top of the figure represents your research concerns; the rectangle at the bottom represents your interview transcripts. The question mark in the middle represents the gap between them, in other words, the difficulty in seeing how your interview transcripts bear.

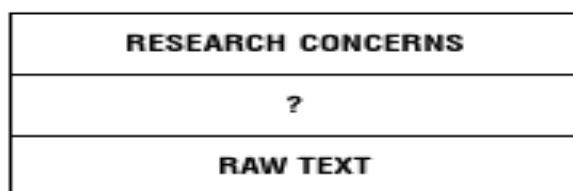


Figure 28: Research concerns and raw text

The Basic Ideas directly in the massive amount of text faced with during analysis of the transcripts. You will then develop your theory from these patterns. Adrift in a Sea of Data: Your Experience at the Start of Data Analysis After you finish reading all of your transcripts, you will almost certainly feel overwhelmed by the data, simply because there is so much text to deal with. You will be struggling with two main issues. The first issue is that you are likely to think that everything is important. You will be afraid to choose any one thing to focus on, because you will be worried about leaving something out. Many beginning researchers become stuck at this stage. They are unable to do anything because they assume that there is “one right way” to interpret the data. They are so afraid that they will not be able to find that “one right way” that they cannot begin the coding process. They cut and paste various parts of the transcripts. They call in their research advisers for help with what to do next. In short, they are immobilized. We have found that the best way to work through this paralysis is to remember that your interpretation of the data will be only one of several “right ways” in which the data can be interpreted.

As a theorist you are free to make either interpretation, provided that you can support it with further textual evidence. Assuring beginning researchers that there is not one right way (i.e., the truth) that they must discover seems to loosen up the paralysis and allow them to begin coding.

The second issue is that beginning researchers, in addition to believing that everything is important, simultaneously find it hard to see how anything in the interviews bears on their research concerns. This is partly because of the sheer volume of text, but also because the research participants were addressing their own concerns, rather than yours. It may happen that the participants have concerns that do not prove to be related to yours. When this happens, it is important to include the participants' concerns even if you do not understand them. If they do not fit into your theoretical framework, those ideas can form the basis of your next research project. If you are truly interested in the subjective experience of the participants, it is their concerns rather than the researchers' that must take center stage. This is an important point, particularly for researchers doing qualitative research for the first time. So don't worry if you find your ideas changing as you analyze your data. It's a common occurrence in data analysis, and a sign that the process is going well. This issue is not just something that happens to beginning researchers.

Moreover in the book of *Qualitative Data: An Introduction to Coding and Analysis*, Auerbach and Silverstein (2003) explained in details the mechanics of coding the step-by-step process used to transform the raw text of the transcripts into a theoretical narrative. Their coding procedure has six steps, which are shown in Table 6.

Table 6: Six steps for constructing a theoretical narrative from text

Six Steps for Constructing a Theoretical Narrative from Text

MAKING THE TEXT MANAGEABLE

1. Explicitly state your research concerns and theoretical framework.
- 2.-Select the relevant text for further analysis. Do this by reading through your raw text with Step 1 in mind, and highlighting relevant text.

HEARING WHAT WAS SAID

3. Record repeating ideas by grouping together related passages of relevant text.
4. Organize themes by grouping repeating ideas into coherent categories.

DEVELOPING THEORY

- 5.-Develop theoretical constructs by grouping themes into more abstract concepts consistent with your theoretical framework.
 - 6.-Create a theoretical narrative by retelling the participant's story in terms of the theoretical constructs.
-

The six steps are organized into three phases that we have named: making the text manageable, hearing what was said, developing theory; each phase deals with a different level of analysis. In the first phase, making the text manageable, you work at the level of the text itself. This is a filtering process, in which you choose which parts of your text you will include in your analysis, and which parts you will discard. In this phase you use your research concerns (Step 1) to select relevant text (Step 2). In the second phase, hearing what was said, you work at the level of the subjective experience of the research participants. The participants may be interviewed in groups, which is their research strategy, or individually, which is the strategy of other investigators. Either way, in this phase you organize the relevant text into repeating ideas (Step 3) and organize the repeating ideas into more general themes (Step 4). In the third phase, developing theory, you work at a more abstract level to group the themes into more general concepts, which we call theoretical constructs (Step 5). Finally, you use the theoretical constructs to create a theoretical narrative (Step 6).

Although we present the steps sequentially, the coding process is not a linear movement from Step 1 to Step 6. Rather, as you code you will find yourself going back and forth between steps. As you become more and more familiar with the data, you will realize, for example, that a repeating idea that you originally coded as reflecting one theme, actually makes more sense grouped with the repeating ideas under a different theme. Or you might decide that two separate

themes could be collapsed into a third, more comprehensive theme. Thus, the process of coding is complex and requires patience. We present these steps as a linear progression only for ease of exposition.

Robson (2002) have explained that Coding schemes consist of predetermined categories to record what is observed such as noting whether or not a certain type of behavior has occurred to complex multi-category systems. Once the research question is clear, relevant important concepts need to be clearly defined and then strategies planned for measuring these concepts with sufficient reliability and validity. A reliable coding scheme and measuring instrument is often dependent on the observer's skills. However training observers to produce the same set of codes when observing a sequence of behavior is very time consuming. An efficient coding scheme and trained observers would assist in attaining good inter-observer reliability. These observational models have been developed over the years. Although there is a small distinction between observation systems which can be based on checklists ("long series of items which are recorded as present or absent") or category based systems (smaller more general list of items).

Experimentation and coding schemes

For structured observation in field experiments, simple coding schemes are typically used. The researcher needs to actively decide what type of activity or behaviour will be observed that will capture sufficient data for the research question in mind. In order to develop codes, Weick (1968), (Weick 1968 cited in Robson (2002)), suggests four adaptable possibilities:

1. Non-verbal behaviours: any bodily movements not associated with language
2. Spatial behaviours: the extent to which individuals move towards or away from each other
3. Extra-linguistic behaviours: any verbal behaviour in addition to words themselves such as speaking rates, loudness, interruption tendencies
4. Linguistic behaviours: the actual content of talking and its structural characteristics

Deciding on a coding scheme:

In addition, Robson (2002) advocates following the mainstream methodological route where the research question is identified, refined through pilot work, which then leads the researcher to a create a specific coding scheme. Interval coding systems can be used which refer to coders

coding at specific times, such as every coding behaviors every 10 seconds onto recording sheets to generate ten minutes of coding. This requires coders to be fully familiar with all codes identified. More than one coding system can be used in a study.

Devolving your own coding scheme:

Any behaviors and distinctions of importance to the research questions need to be identified for coding, Robson (2002) suggests some considerations in developing a coding scheme:

1. Focusing on behaviour that is useful to the research (not simply observing and coding everything)
2. Objectively coding with little influence of the researcher in the environment
3. Codes must be explicitly defined and a detailed definition with examples should be provided of that which does and does not fall into the category
4. The coding scheme should cover everything (e.g. having "residual" or "dump" category)
5. There should be a single category for each thing coded (coding system maybe both explicitly defined and exhaustive)
6. Easy to record such as ticking a box as opposed to recalling each category, as mentioned before observers must be very familiar with the coding system before use

Also, Byrne (2002) discussed the coding process and clarified that once data collection is complete, the researcher moves onto the coding process which begins with reading over transcripts and forming a general impression. This moves onto initial coding where a coherent narrative from the data starts to be constructed whilst data is initially coded for significance and relevance to the research question in mind. Transcripts can be read separately in the early stages and the researcher can create a scheme of classification to assign coding. The process involves scanning where the initial coding of transcripts is read by researchers. This moves onto searching where "text-search facilities" that contain appropriate texts are used and coded if deemed relevant. Retrieval is also part of the coding process where parts of the data are accessed again to stimulate coding, or where they may suit a more accurate theme or inform new ideas and sub-themes.

Finally, Miles and Huberman (1994) simplified the thematic analysis by a definition that is saying 'coding and analysis are both synonymous where data or notes need to be transcribed, meaning carefully extracted and condensed skilfully through coding into a clear account', explaining that codes are applied which are tags or labels for assigning units of meaning to descriptive information; these can be applied to "chunks" of data from words, phrases,

sentences or whole paragraphs. Words do not necessarily contain meaning but meaning is inferred by its importance in a framed context which researchers may or may not be aware of. Coding helps to retrieve and organise large amounts of data, from which pertinent information can be extracted relevant to the research question. Coding can be applied at various levels of data analysis (both descriptive and inferential and then grouped into themes that represent groups of meaningful ideas to represent the qualitative account.

Coding, thematic and interpretative analysis

There will be combination for both of quantitative and qualitative analysis based on the nature of the questions of the questionnaires. In reality, the analysis of the majority of surveys questions will be through the coding, thematic and interpretative analysis as a qualitative method.

3.2 Research questions

Techniques of questioning are employed both at the microcosmic level of formulating appropriate types of interview in order to collect data and also at the macrocosmic level of the broader questions of the research itself. The research questions in their simplest terms, state what we are attempting to find out, whilst the hypothesis aims to provide predictions to such questions (Punch 1998).

Types of questions.

One of the most useful typologies of research questions is provided by De Vaus (2001, p. 1) who divides research questions into two categories, the 'descriptive' and the 'explanatory'. He argues that social researchers create two fundamental types of research questions:

- 1- What is going on? Forming the descriptive research.
- 2- Why is it going on? Forming the explanatory research.

Also the W-Questions or Journalistic Six (who, what, where, when, why and how) are usefully divided as shown in the table 7:

Table 7: Descriptive and explanatory questions

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Source: (de Vaus 2001 & White, P., 2009)

Denscombe on the other hand, divides questions into six types, according to purpose (2002, p. 26):

- 1- Forecasting an outcome or making predictions
- 2- Explaining causes or consequences
- 3- Criticising or evaluating
- 4- Description
- 5- Developing good practice
- 6- Empowerment

This detailed consideration of the criteria of questioning facilitates the formation of the major research questions introduced in chapter one, which will now be discussed.

The Major Research Question

The main research question of this study is, to reiterate: *To what extent can Integrated Urban Water Management in Saudi Arabia be enhanced by positive stakeholder/public participation and public awareness?*

In order to fully address this question, the following sub questions have been formulated:

1. What is the current level of public awareness of water issues?
2. How much public engagement is likely?
3. How and to what extent can public engagement be stimulated to enhance integrated urban water management in KSA?
4. How and to what extent can public engagement be harnessed to enhance integrated urban water management in KSA?

The responses to the main research question and the sub questions will be informed by the philosophical perspective of this research which is the Interpretative paradigm. Previously it was stated that this was an inductive method comprising qualitative and quantitative methodologies and that this strategy is particularly appropriate for the nature of this study. In the light of the research questions, we will return to these methodologies from an analytical perspective.

Based on the research onion (Figure 25), the Figure 29 below explains briefly how the methodology of the research was applied from the philosophy of the research to the procedures of the data analysis.

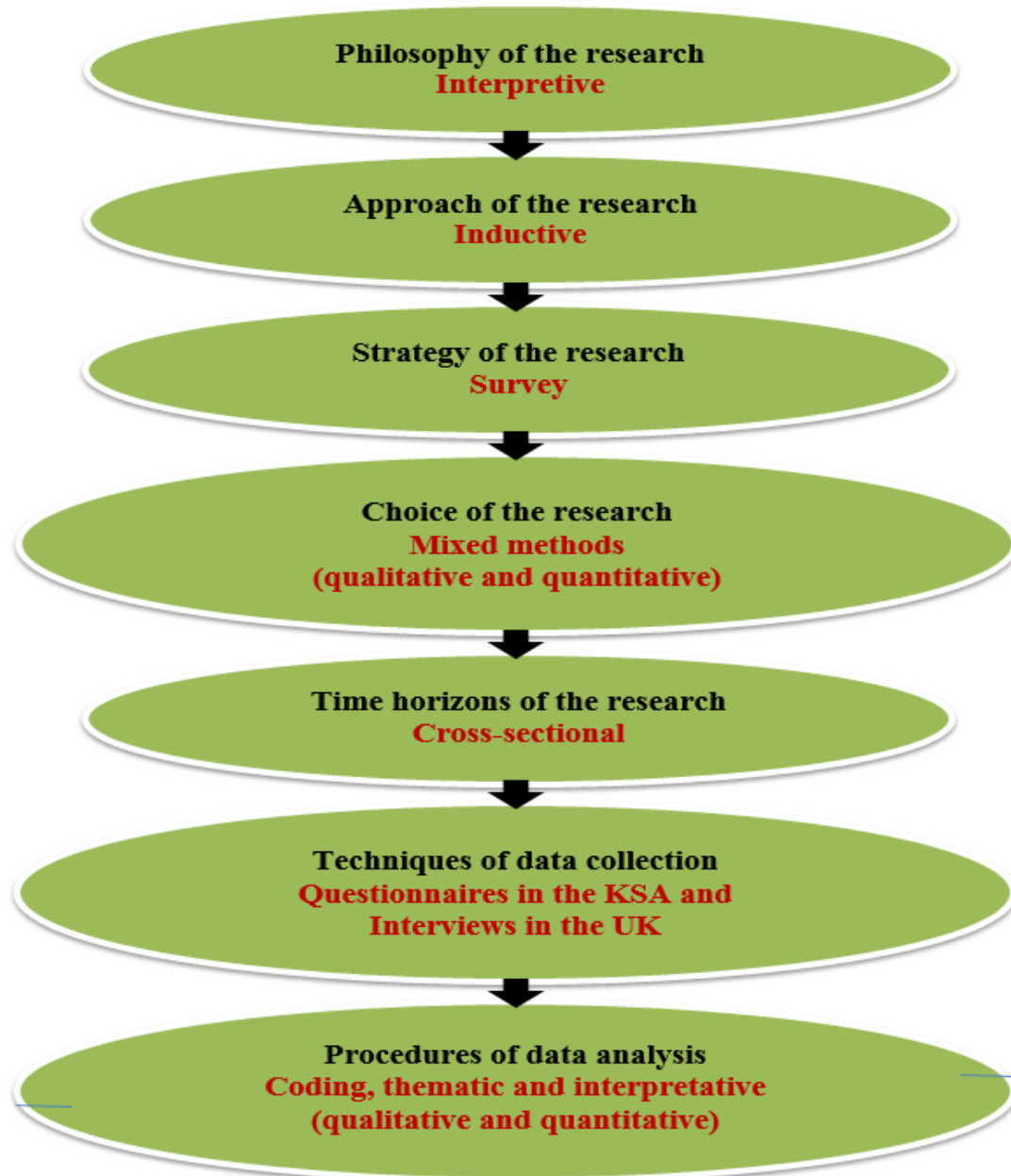


Figure 29: The research methodology

Research design

In this thesis, there was a combination of both quantitative and qualitative analysis based on the nature of the different aspects of the survey. The majority of survey questions were analysed through the method of coding, thematic and interpretative analysis. A survey strategy/methodology was used to investigate public and stakeholder participation in applying IUWM in Saudi Arabia.

Field trip in Saudi Arabia

Three groups of stakeholders were selected in the survey to provide a full picture about the current situation. In order to cover the different geographic areas of KSA, three regions were selected (Figure 30), the first region is Riyadh which is the capital city and it represents the desert areas that most of Saudi cities are located in; the second area is the Jeddah city which is a symbol of the coastal areas and cities in Saudi Arabia containing the commercial port (Jeddah Islamic Port). The third region is Al-baha city which represents the cities located in the mountainous regions in the south west of the KSA. Furthermore, the weather in these three cities are invariably different where in Riyadh the weather is very hot and dry in the summer season, and very cold and dry in the winter time. Whilst in Jeddah the weather is very hot in the summer period, with very high humidity, although the weather is mild in the winter time. Al-baha has fairly mild weather in the summer time but it is cold in the winter season with seasonal rainfalls in both the winter and summer.

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Figure 30: Map of the three selected regions for the teachers and the public in the KSA; (Ar= Arriyadh/Riyadh, Je= Jeddah and Al=Albaha)

Groups of stakeholders

Teachers and Public groups: The current study has investigated water awareness in general education from the teachers' perspective by collecting different views of teachers from three of the main cities in KSA which have different geographical conditions. Data collection was achieved through a personal administering of hardcopy questionnaires collecting 60 responses from 60 teachers during a field survey for 3 months; and the researcher also administered the questionnaires one-to-one.

Identification of the public sample

There were 90 Saudi nationals/citizens (45 males and 45 females), and 30 foreign people/Non-nationals as detailed in the table below:

Table 8: Identification of the public sample

Selected cities	Riryadh	Jeddah	Albaha
45 saudi males	15	15	15
45 Saudi females	15	15	15
15 foreign males	5	5	5
15 foreign females	5	5	5

Identification of the Teachers' sample

Table 9: Identification of the Teachers' sample

30 male and 30 female teachers from 60 different schools								
12 male and 12 female schools in Riryadh			9 male and 9 female schools in Jeddah			9 male and 9 female schools in Albaha		
4 male and 4 female	4 male and 4 female	4 male and 4 female	3 male and 3 female	3 male and 3 female	3 male and 3 female	3 male and 3 female	3 male and 3 female	3 male and 3 female
Primary school	Intermediate school	High school	Primary school	Intermediate school	High school	Primary school	Intermediate school	High school

Group of water policy makers, professionals and managers, environmental managers, technical practitioners and engineers, industrial managers, lecturers and academic

In this group there were 40 participants as follows: eight water managers/politicians in the Ministry of Water and Electricity, four water managers in the Saline water Conversion Corporation, two managers in the Ministry of agriculture, and six environmental managers in the Presidency of Meteorology and Environment, three surveys with technical practitioners/engineers in the National Water Company, five surveys with industrial managers in Saudi Aramco company, and four industrial managers in Saudi SABIC company, and Seven

academics from researchers in King Saud University, and only one academic from the King Fahad University.

Administering surveys in the UK

In the UK interviews were carried out with five water managers in the selected five water companies in the UK, categorised anonymously in this research as follows; Company A, Company B Company C, Company D and Company E. Each interview was carried out with a representative from the water company at the company headquarters.

Administration and distribution of the questionnaires

Data collection was through a personal administering of hardcopy questionnaires collecting responses from the selected stakeholders (220 in Saudi Arabia) during a field trip. In the process of data collection, all of the questionnaires were administered 'face-to-face' and all of the participants had written their answers by hand after they signed the Consent Sheet and read the Information Sheet (see appendix 8 and 9). According to the distribution process, the survey was carried out over three months in Saudi Arabia.

Group of general public participants

Most of the participants interacted with the researcher whilst they completed the questionnaire, and most of the participants used to sit down on chairs inside the Malls, and only few people had answered questionnaires while they were standing in the street. Also, some of the hardcopy questionnaires were distributed in the mosques and some of the participants whether the Saudis or the foreigners/non-nationals, took the questionnaires and gave them back the next day.

Group of teachers

While collecting the 60 responses from 60 teachers from 60 different schools, most of the participants interacted with the questionnaire. Although many did not fill the questionnaires on the same day of the distribution, and therefore were collected two days later and sometimes three days later.

Group of Group of water policy makers, professionals and managers, environmental managers, technical practitioners and engineers, industrial managers, lecturers and academics

The survey started in Riyadh with the Ministry of Water and Electricity, the Saline Water Conversion Corporation, the Ministry of Agriculture, the National Water Company, and Saudi SABIC company, and King Saud University. Later, the questionnaire was distributed in Jeddah city in the Presidency of Meteorology and Environment. The last survey was distributed in the eastern region of Saudi Arabia in the Saudi Aramco company, and in the King Fahad University.

Translation of the questionnaires

From English to Arabic

The collected data was translated into English language, then proof reading was carried out by a translation company in Riyadh, to ensure that the Arabic version of the questionnaires were giving the exact translation of the English version of the questionnaires.

From Arabic to English

After three months of data collection from Saudi Arabia, during the process of analysis, the researcher translated the Arabic responses into the English language, then the proof reading was carried out by a translation company in Riyadh to ensure that the English translation of the Arabic responses were 100% accurate.

Validity and Reliability of Research

Holliday (2007) suggests that the quantitative researcher is required to record details of research procedures, whereas the qualitative researcher intends to justify each individual action. This demonstrates how the overall strategy of the research is appropriate to each individual social setting and the participants' relations within it. It will also take into account the different stages that must be taken to achieve a thorough and comprehensive process.

The objectives of conducting questionnaires

The questionnaires will form the basis for the discussion chapter and the contribution to knowledge that this thesis will present. The questionnaires, the stakeholders were then divided

into three groups in terms of the expected levels of interaction in the process of conducting the surveys. The objectives of selecting each group of stakeholders in relation to practices, applications, and governance of IUWM in Saudi Arabia are discussed as follows.

Group 1: A- Water Policy Makers and environmental managers

This group consists of five categories within two main groups. Firstly, water managers. These include water planners, water politicians with direct authority over water issues i.e. the Ministry of Water and Electricity and the Saline Water Conversion Corporation (SWCC). Secondly, there are environmental managers. These are within the relevant governmental authorities; the Ministry of Agriculture and the Presidency of Meteorology and Environment (PME). The aim is to discover how effective is the information they produce on existing campaigns of raising public knowledge. Also, the level of governmental motivation towards the private sector's involvement in the preservation of dwindling water resources will be measured. The research will also aim to identify and define levels of public awareness and attitudes to water saving measures through the impact of water rationalisation campaigns.

B- Technical practitioners and industrial managers

This group includes water engineers and water experts in the National Water Company. Also, managers in the Saudi Aramco company (the world's leading integrated petroleum enterprise), and the Saudi SABIC company (the world's largest petrochemicals manufacturers). The goal is to measure the relevance between the private sector and other stakeholders for the promotion of good practices including the sharing of technological information to assist the implementation of IUWM. Technical practitioners will be challenged to reduce water consumption and wastewater quantities in the industrial sector through waste minimisation programmes. Also, a demand orientated approach to sustainable water reservoirs will contribute to positive progress in levels of participation.

C- Lecturers

This cluster contains water researchers and water professionals in Higher Education in the Civil Engineering field of Water Management. The aim is to investigate to what extent they can work together with the water authorities to improve public awareness and to find out how researchers can participate positively in helping the achievement of IUWM.

Group 2: Teachers

These are teachers in both girls' and boys' schools (primary, intermediate and high schools) in the general education. The aim is to investigate to what extent teachers can work together with the water authorities and organisations to improve public awareness and to find out how teachers and other participants in the education sector can participate positively in promoting the achievement of IUWM in the kingdom.

Group 3: The public

This involves individuals who are the participants or consumers of water in the Saudi community, including non-nationals. The group is made up of consumers in Riyadh city and in Jeddah and in Albaha. In general, the aim is to collect data around public ideas and attitudes to urban water practices to form a basis for a paradigm based on communication and ownership. In addition, it will be necessary to know to what extent consumers know their rights and duties to the water management system, how they deal with the water issues on the ground and how they may be able to affect water services system decisions. In this group, specific data will be required to make an assessment of the extent to which public awareness and public participation can enhance the role of IUWM.

In total 220 participants were selected, 40 people were either environmental or industrial managers or lecturers and researchers , 60 participants were teachers and 120 people were from the public. These methods of data collection will be further discussed in the next section.

3.3 The Research Plan

Data Collection Procedures

The procedure for data collection has involved personally conducting interviews and questionnaires. Interviews were conducted with UK water managers. The research interview lasted approximately from twenty minutes to half an hour per person. The answers to the interviewer's questions were recorded in order to gain more accurate and relevant information for the transparency of the data. Questionnaires were carried out with respondents from the three groups of stakeholders. The researcher visited the Kingdom of Saudi Arabia to conduct these questionnaires with a selected sample from the three groups of stakeholders. A total of two hundred and twenty responses from participants were collected. Transcripts of the questionnaires are available in the appendix.

A pilot process of the surveys was conducted in order to ascertain the effectiveness of the research questions in fulfilling aims and objectives of the study. The pre-test was carried out among ten students in the UK who all have a background in water management. The results were encouraging and gave a positive signal that the required data was achievable.

Data Collection – Saudi Arabia

In the field trip 220 responses were collected as shown in the Table 10: the collected stakeholders' samples.

Table 10: The collected stakeholders' samples

The types of Stakeholders in relation to the research purposes	Collection Instrument	No.	The selected stakeholders including gender breakdown.
<p>Water Policy Makers and environmental managers</p> <p>Technical practitioners and industrial managers</p> <p>Lecturers and Researchers</p>	questionnaires	40 males only	<p>With eight water managers/politicians in the Ministry of Water and Electricity. With four water managers in the Saline water Conversion Corporation.</p> <p>With two managers in the Ministry of agriculture, and six environmental managers in the Presidency of Meteorology and Environment.</p> <p>Three surveys in the National Water Company,</p> <p>Five surveys in Saudi Aramco company, four in Saudi SABIC company</p> <p>Seven from researchers in King Saud University, one in King Fahad University</p>
Teachers	questionnaires	60	30 surveys from male teachers and 30 surveys from female teachers (from single sex boys and girls schools including primary, intermediate, and high school)
The public	questionnaires	120	45 with Saudi male and 45 female citizens. 15 with male and 15 female non-nationals.
The total of surveys	220		

Transferring the learning from UK/EU experience to the Saudi Situation

One of the identifying characteristics of this project is that it is based in the UK and yet has water management in Saudi Arabia as its subject. A feature of the methodology for the project, in particular its analysis of the survey data, will be the identification of opportunities for transferring learning from UK experiences to the Saudi situation. It is envisaged that the two

main types of experience that can be used will be those highlighted by the SWITCH project and from public awareness campaigns that have already been carried out by water companies.

Data collection in UK

Investigation of the UK Water Awareness Campaigns

This study was an important element of the research plan and a similar methodological approach to that of the stakeholders was employed, but in this case the questions took the form of interviews. Fourteen companies were investigated and five were selected in order to carry out interviews with the water managers. Details of the campaigns of all fourteen companies will be presented in the appendix.

Having introduced the unique aspect of this research in learning from the UK water management and explained in detail the background of the methodological choices for this study. This will form the background for the forthcoming survey of stakeholders' knowledge and attitudes. The following chapter will present the data and an analysis of its results.

Chapter 4: Survey with data analysis of attitudes to water issues in the Kingdom of Saudi Arabia.

4.1 The approach to analysis

There will be combination for both of quantitative and qualitative analysis based on the nature of the questions of the questionnaires. In reality, the analysis of the majority of surveys questions will be through the coding, thematic and interpretative analysis as a qualitative method.

This chapter will present and analyse the data which has been collected by the researcher in order to answer the sub questions of the major research question that will be discussed in chapter 9 following. To reiterate, they are:

1. What is the current level of public awareness of water issues?
2. How much public engagement is likely?
3. How and to what extent can public engagement be stimulated to enhance integrated urban water management in KSA?
4. How and to what extent can public engagement be harnessed to enhance integrated urban water management in KSA?

These 4 sub-questions will be addressed via a combination of both quantitative and qualitative analysis of the data collected during the Saudi field trip. The analysis will be tailored to respond to the different forms of questions that were used in the surveys. In effect, this will take the form of a range of techniques including coding, thematic and also interpretative analysis as a qualitative method.

In practice, the data will relate to the sub research questions in this way. The questions refer the respondents' understanding of the currents situation in the Kingdom. Responses to questions three and four will take the form of proposed solutions that the different groups suggest in order to improve the current situation, particularly with respect to raising awareness. Finally, the questions will be addressed as to how an improvement in awareness can translate into actions, in particular positive behaviours with respect to water conservation, including recycling and rationalisation.

Therefore, in this section, the research will first identify the significant data by using a thematic analysis for each individual answer to every question and these analyses will be described in general terms such as ‘the majority of teachers agree..’ etc. The main themes expressed by the main questions of the questionnaires and based on the main themes the significant quotations were selected and included, in order to provide detailed answers to the sub research questions. These quotations will be provided in English translations where all of the quotations were translated from Arabic to English except some of the Academics' quotations were selected as there are, due to the fact that, some of the Academics replied in English (in which the English version was quoted), where I provided a version of the questionnaires in English to every single participant. The data analysis will be divided into the three groups of stakeholders. First, the cluster of teachers, second, the cluster of water managers, engineers, technicians, experts, lecturers, researchers, environmental managers and industrial managers and third, the public.

4.2 The Teachers’ surveys

The sub questions addressed by the analysis of the teachers’ surveys will mainly be the first question respecting the current level of awareness and the second, referring to the likelihood of improving awareness in the current situation. The details of the survey questions can be found in the appendix. In addition to this, the research has identified several themes in relation to the main research question and its four sub-questions. They are as are as following:

- The perception of the level of students’ water awareness
- Influences and reasons that have affected the level of awareness
- The role of education and schools in raising public and social awareness
- How schools should raise awareness of water issues
- The relevance of the current curriculum in raising awareness
- The perception of teachers’ enthusiasm for making schools play a role in raising awareness of water issues in society
- The cultural issues/aspects in KSA that make raising awareness problematic

The perception of the level of students’ awareness:

Most of the teachers from the sixty different schools consider that the age of the students is an important factor in their levels of understanding and also of behaviours around water. Age can

impact on children's ability to receive and understand information, to listen and to apply instructions. The result is that the extent of understanding water issues is greater among high school students than the primary and intermediate school students. However it has been noted that there is a general misuse of water by students of all ages.

The responses of the 60 teachers (30 women and 30 men) suggest that there is a spectrum of different levels of awareness among male and female students towards problems and other issues of water in the kingdom of Saudi Arabia. That spectrum is from totally unaware (no awareness at all), through weak awareness to good awareness. However the teachers generally indicate that more than the half the students are at a weak level of awareness. Only a very small number of teachers believe that there is good awareness. In addition it has been discussed that although it is hard to determine and describe the students' awareness just from observing behaviours in schools, it can be best judged through students' reactions to the rationalisation of water consumption inside schools.

Teachers have described this weakness of awareness in many ways. Many teachers described Saudi students as apathetic to water issues. In relation to knowledge about water status in region as a whole, there are many students who have no background knowledge either about the Kingdom of Saudi Arabia or about the Arab World in general. Moreover there are students in primary and intermediate schools do not even know the main water resources in the kingdom. Moreover there were widely differing opinions expressed by the students,, particularly relating to students in primary schools, showing that there is ignorance not only about conservation but also the value and importance of water itself; and many students think that the water is the cheapest and most easily obtainable resource in the world, whereas the reality is that Saudi Arabia is an arid country. (all quotes translated from Arabic).

The current generation does not realise that all Arab countries have been suffering from the lack and scarcity of water resources'(Girls' intermediate school).

The generally low level of awareness led most teachers to express a view that there is a need to increase awareness, because of so much evidence of the wrong practices and behaviours,

particularly in primary schools, with widespread excessiveness of use and a lack of awareness about appropriate levels of water consumption.

Unfortunately, there is not enough awareness about the water issues and problems, and the nature of excessiveness (carelessness and wastefulness) and (non-thoughtful) uncalculated consumption is a common phenomenon in most of the daily life practices and the water usage is a part of this phenomenon. (Boys' primary school)

Reasons and influences that have affected the level of awareness

The Islamic Religion: Several teachers, both male and female have stated that many students show a lack of understanding that water is from Allah's (God's) bounties, and that they must appreciate, care, and conserve water for the sake of Allah. Some teachers cited verses from the holy Qur'an and some of the prophet Mohammed's teachings about water and its usages, particularly that the conservation of water is a religious Islamic obligation. This is evidence that the use of religious instructions can have a positive effect on water issues. The Islamic religion influences the daily lives of Saudi people and provides them with an index or key that will enable them to see water issues from a religious perspective.

Raising awareness will never success unless it is linked to Islamic religion in terms of the fear of God to be the recipient of a great reward from him (God/Allah). (Girls' intermediate school)

The family and home influence: Several teachers have expressed a belief that many Saudi families do not carry out their responsibilities for the education of their sons and daughters with respect to public amenities and facilities. As a result there is a general lack of concern with respect to these amenities, including the provision of water in schools which should rather be protected and conserved as a national duty. In general, it has been found that many families have contributed to this lack of awareness among Saudi students.

The impact of the media: Teachers have addressed another reason that contributes to this weak level of awareness. This is a lack of advice and instructions that could be taught through the means of different media.

The awareness of students about this issue (issues and problems of water in Saudi Arabia) is very weak and there is because of the lack of media attention to this issue. (Boys'intermediate school)

The role of nursery education: It has been shown children of nursery age should receive a basic understanding of water issues in order to prepare them for primary school so that they can apply this knowledge when they move into this new educational environment. In this way, age should no longer be a barrier to awareness and children will be prepared to react positively to water issues and accept instructions about appropriate behaviours, as they move through the different stages of their education towards high school.

A sense of responsibility: Teachers have confirmed that many students have a lack of the sense of responsibility towards water issues. This applies in particular to primary school children. For this reason, many teachers have advised that this concept of personal responsibility should be instilled from an early age and that there should be a continuing education about water issues starting at the earliest level, in order that children should see water as a vital part of the national wealth and that its loss will have disastrous results.

The students do not have enough awareness towards water problems and there is no responsibility towards water conservation. (Girls' intermediate school)

Aspects of positive awareness: Some teachers declared that there is evidence of awareness, even of good awareness, but that it is insufficient to have much impact due to the scale of water issues in the kingdom. Current levels of awareness are not year comparable with conditions. In addition, this group of teachers pointed that although there was an accompanying improvement in levels of awareness after the Ministry of Education's adoption of rationalisation, a significant percentage of students have yet to be influenced. This is compounded by the fact that there is no consistent discourse around water issues, with the result that there is no corresponding culture of learning, for example of reading and updating knowledge. Moreover, there is still a need for a fuller evaluation, observation and improvement in behaviours with respect to water usage from teachers and society in general.

There is some awareness but the awareness needs to be more widespread and the students need to have more awareness.(Girls' primary school)

Finally, some teachers illustrated that the small number of students who have sufficient awareness and knowledge about water issues, are beginning to discuss these issues and problems. Some of them are even thinking about water issues and making suggestions about how to improve the provision of water services in the kingdom. It was the girls in particular who expressed these positive views, summarised by one of women teachers in a high school;

The female students have an awareness of the extent of the significance of water and its numerous daily usages. To achieve water rationalisation by the correct means that students can realise and apply, the students have to be informed and observant to the water problems (on the ground), and (advise them) not to waste, as the messenger (Mohammed) said 'do not waste water even if you were at a running stream (river)', and the level of awareness of female students in the issue of water was above 50%. (Girls' high school)

The role of education and schools for raising public and social awareness

The Current Situation in Schools

Many teachers indicated that there a notable weakness in the programs of raising awareness throughout the whole of the education sector, including its foundations. The education system has failed to address water issues in any depth and has also failed to understand the need to plant the origin of awareness in students' minds, despite the fact that the general low level of awareness necessitates a comprehensive improvement. Significantly, some teachers have pointed out that there is a need for improved subject knowledge in the profession, so that teachers can become positive role models. It is essential that the General Education Directorates address this.

The education sector does not perform any role for the awareness of society towards water issues. (Boys' high school)

The months are coming and going and there is no guidance and instruction about the water issues and problems. (Boys' high school).

On the other hand, a small number of teachers believe that the current education system has improved levels of awareness in explaining water issues and problems to students. In addition it has given them a role in sharing information about the nature of water issues in order to be advocates to improve societies' awareness in relation to water issues in the Kingdom. However, these teachers also believe that there are organisations and centres (non-educational associations, for example cultural centres in Riyadh) that are more effective than schools in promoting important programmes of awareness.

The education sector has a role in providing some awareness but there are programs, that have been conducted by other centres (cultural centres), more significant than education (what has been done in schools), and we wish that these centres should intensify their useful awareness programs. (Boys' intermediate school)

The importance of the role of education

To summarise, teachers have demonstrated the role of education in raising awareness is also a national duty. To achieve this, students need to be aware of their own duty and responsibility towards water issues, which teachers need to clearly explain through the opportunities within the school curricula and through their own positive example.

Teachers strongly believe that first and foremost, the fundamental role of education is to raise awareness of key issues for society, because schools teach the parents of the future. However, some of surveys also indicate that the process of raising awareness must be equally evident outside as well as within schools. Therefore, the role of the family and the home in the process of raising awareness is as important as the role of the education sector.

The education sector in general, whether general education or higher education, can play a major role in raising awareness through making the education sector engage in tasks and activities that are highlight water problems and the optimal ways to solve them. Therefore both the teacher and student will benefit and consequently through them, families and society will benefit as a whole. (Boys' primary school)

The possibility for making school play a role in raising awareness of water issues in society

Having presented a comprehensive overview of the extent of the current level of public awareness and the likelihood of engagement in the current situation (as in sub questions one and two), overall teachers believe that current levels of awareness are low and that the education sector has a limited influence at present due to its lack of attention to water issues in the curriculum. There is, however, the potential to play a much more significant role particularly if schools can work in partnership with families to indirectly educate both students and teachers. This moves the discussion on to sub questions three and four, which address how and to what extent public engagement can be stimulated.

Furthermore, most teachers confirmed that the education sector can have a wider influence in educating different employees, whether teachers, administrative workforce or cleaners. In addition to this, teachers also strongly believe that the fundamentals of public awareness can be embedded through education, (particularly at nursery level) where it can begin to play a key role in shaping the consciousness of the whole community about issues which will affect them directly.

The majority of teachers also confirmed that it is essential for the Ministry of Education to take an interest in how schools can benefit the awareness of society, through making developments in the field of awareness in general. Moreover, the Ministry take responsibility and encourage teachers and other staff members to undertake voluntary work and to cooperate with regard to water issues, instead of leaving this to water organisations and governmental initiatives.

From this, teachers shown that there is a need to become actively engaged in voluntary work within the education sector professionally. The thinking from teachers is that if schools become more active in voluntary work, there will definitely be positive results. This is because the education sector deals with many different levels of society including children, their parents and the parents of the future. This is what makes education unique among other sectors. Teachers are in agreement about the importance of schools and their unique role in contributing actively to increase the awareness of different issues throughout society. The influence of a school can expand into the whole community through the larger community of the school itself. All workers,

writers, reporters and students are in a position to take responsibility about national issues. In addition, students' awareness and attitudes can be transferred to the home in order to address the current low levels of awareness among parents. In this way, schools can work successfully in partnership with homes. Public engagement can be stimulated in this way.

Yes, it is appropriate for schools to play a role in raising awareness of water issues in society, and even it is necessary for schools to play a role in raising public awareness by educating students and their families because the school is the place where all segments of society are meeting in. (Boys' intermediate school).

It is to be noted that the primary schools teachers are more aware than the others of the importance of this stage in education. They describe it as stage of instilling values and principles, especially in the three first classes. In addition, primary teachers focus on the issue of rationalisation above all other issues because teachers believe that the school community consumes a large amount of water.

Another important issue is the influence that teachers can exert on the minds of students. The thoughts and words of teachers have the potential to affect the psychological behaviours and emotions and even the ideology of individual students. Therefore, it has been demonstrated that the role of the teacher within the culture of education is one of the main reasons why schools have the potential to play a significant role in raising awareness. This is in part due to the fact that teachers are already educated and also because of there are is a significant number of girls and boys who can be positively influenced by teachers. Moreover, some teachers while instilling the values in their students, are able not only to influence the students so that they will be receptive to the positive ideas, but also to bring a sense of normalisation and custom to these ideas. The instillation of these good habits can then become part of a student's everyday life and personality.

Schools have a big role because they are the first founder of the ideas and behaviours of the students, so it is essential that this role begins in primary, and through a deepening the principle of water conservation in lessons and in the school activities. (Girls' elementary school).

In addition, many teachers explained that the reason for the schools' unique capability to play a role in raising public awareness is due to the fact that comprehensive education can include all society. A school is a source of information and can be considered a second home for students. Therefore the time, that students spend in school, and the potential for learning in the education sector are two key factors that can work to achieve the success of the education sector in raising public awareness. Overall, teachers are optimistic that schools can play a positive role in organising water awareness campaigns in local areas, in streets and in major malls.

The education system has both the possibilities and the time to spend with young people, the teacher deals with students, and they can make a change, more than anyone else. The teacher has priority to be on the head of actions in raising social awareness, especially about the crucial issues in a desert country, water is one of the most central and very dangerous issues, unfortunately there are less important and less dangerous issues than water issues but people here are still concerned about them. (Boys primary school)

The perception of schools' interaction in World Water Day

World Water Day is an annual event celebrated on March 22. The majority of teachers claimed that most schools did not make a full response to World Water Day (WWD), in some cases it was not even mentioned. Also, many teachers admitted that they had no knowledge of the existence of WWD. However, despite this, they are aware of the importance of the matter and have expressed surprise that there was no interaction between schools and the Saudi media in order to publicise the event. Only a few schools had any positive interaction with this event and its relation to the water situation in the Kingdom, others had very limited interaction. It is worth mentioning in generally, positive attitudes and actions were more predominant in girls' schools.

Some teachers explained that one of the reasons for not engaging with World Water Day was because, sometimes it took place during the weekend in Saudi Arabia. However, it can be argued that such a reason is an evasion of responsibility because WWD could have taken place the previous week or even the week after.

I swear to Allah (God), we have never heard about it (the World Water Day), because of the lack of awareness about it. (Boys' high school).

There was no activation due to the lack of knowledge about the date of the World Water day; and it is a necessity to activate it and to make people aware there is a World water Day. (Girls' primary school).

On the other hand, among the teachers who had indicated some activity with respect to World Water Day, some explained that the interaction included a range of awareness programs, such as competitions, either in the school or between other schools in the province or region. For example there was a competition for the best proposal that contributed to rationalise water consumption. Another example was a contest to choose the best brochure that displayed the importance of water. Some schools distributed leaflets, made presentations and displayed instructive posters or sheets on walls and there was encouragement given for students to carry out research in the field of water. Some schools restricted their activities to the morning broadcast, others continued to interact with the event on the following week, for example sending students to visit the Directorate of Water in the province.

Finally, a very important point indicated by teachers gave notice that the WWD activities had an initial positive effect on students' behaviours but that it had disappeared in the space of a few weeks.

...it had been activated through a program of broadcasts and films prepared by teachers and students and through a wall painting and drawings, the school had participated in a local educational competition in this regard, and the school had won in the competition.(Girls' primary school)

Yes we had interacted with World Water Day with some brochures and leaflets, which were not kept for a long time and had been thrown in the corridors, but it did not have a positive impact. (Boys' high school)

How can schools raise awareness of water issues?

Having looked at the potential of schools to stimulate public awareness, sub question four now needs to be addressed in more detail, namely how exactly can schools work to achieve this and to what extent can this engagement be measured?

Most of the teachers interviewed expressed the need for a cultural change to take place so that students will be able to fully benefit from an increased awareness of water issues in schools. This cannot however be achieved, except through the Ministry of Education itself, which must take on board the importance of water awareness and ensure that the Education Directorates, in all provinces, have access to means by which they can be really effective in raising awareness.

The teachers have made the following suggestions for the consideration of the Ministry of Education:

Methods of raising awareness through the curriculum:

Firstly, teachers strongly believe that a strategy should be planned to systematise a programme of awareness-raising throughout the curriculum. The plan should take into account both the evaluation and assessment of current curricula and also take into account students' reactions to them. In this respect, many teachers believe that the education system can do more to improve its role in educating students through including water issues professionally in the curriculum. This could be achieved by making and allocating relevant links that refer specifically to the themes and problems of water in different dimensions of health-related issues and also in students' behaviours. There is also a need to regularly update the content of current curricula in relation to water and to improve the details and explanations of some subject information.

The awareness will not exist excepting by conducting a strategy and approved/studied plans for ways of raising awareness via the curriculums. (Boys' intermediate school)

Some teachers believe that in order to raise awareness, specific information about the importance of water should be added to suitable subjects or courses, particularly at the stages

of primary and intermediate schools. These could include science modules (called Alouloom in Arabic), Arabic language modules (these are called 'My Language' in the first three years of primary school, 'My Beautiful Language' in the second three years of primary school and 'My Eternal Language' in intermediate school), Social Studies modules (geography and history) and the English language module.

Other teachers have had ideas about the possibility of establishing a new subject module or course in social and environmental issues. A new module could take the name of '*important issues*' including the problems faced by the Kingdom and including water issues. Similarly a module called '*information and activities*' could be added to address important topics such as the issue of water.

Education can increase awareness by the inclusion of the importance of water as teaching material within the curriculum in which we have to emphasize the importance of water and be honest with ourselves that the most areas of the Kingdom are desert and the water resources are few, also we have to demonstrate the high cost of desalination and there is a possibility of our inability to secure it in the future. (Boys' primary school)

The role of the teacher

Some teachers have pointed out the need to educate some of their colleagues in order to raise awareness within the profession itself, and to encourage teachers to see himself or herself as a role model or inspiration for students. Furthermore, in order to ensure this positive role, the Ministry of Education and its directorates must be concerned about the teachers' levels of awareness and the development of their skills. The role of teachers may even extend to including water issues in exams. Teachers could support students through their own subject knowledge. The morning broadcast could give teachers the opportunity to speak directly to students about water issues.

The possibility of working in partnership with water services could also have a significant role in raising awareness. They could contribute by assisting in preparing the water flyers. There has also been a suggestion among teachers for cooperation between the Education Ministry and the Ministry of Water and Electricity in the preparation of water brochures.

Briefly there must be a conducting of awareness programs for male and female teachers in advance of students, because if you are unaware yourself, you cannot promote awareness; and the role of education is through delivering leaflets and lectures and the most important role is that of the role model (at school).(Girls' elementary school)

Monitoring students

As part of their role in monitoring the students' behaviour with respect to water use, teachers have suggested that this will be more effective if a monitor is given the responsibility to observe students' use of water, particularly at the time of prayer (Dhuhor Prayer at noon) where a large amount of water is wasted through the principle 'It is not our home'. This habit of saying that 'school is not our home' shows a cultural dimension to students' failure to save water at many schools. This has also led to the failure to embracing the principal that water in school is for all the students and should be as important as water at home.

Based on this, both the monitoring of students and a level of correction should be seen by some as a requirement for teachers. Some teachers also advocate firm action against students who fail to listen to instructions about water use, such as reducing the marks for politeness and good behaviours in the students' records.

To raise awareness, it is raised by doing punishments as solutions to prevent extravagance in using water, for example, when we see the students on the school campus playing with water and laughing; if the students are educated and informed and directed properly, nothing happens like this. (Girls' high school)

Practical demonstrations of the current conditions of water

Teachers have frequently made the point that the current education system should present information regarding the current status of water through scientific and mathematical evidence, including future predictions and expectations for the Kingdom. This would enable the clarification of the processes and the difficulties around the provision of water services, comparing the Kingdom with other countries that have similar conditions and demonstrating how people are suffering to obtain water for agricultural, industrial or domestic purposes.

This process could be termed an awareness methodology. It could have influence if it begins in the classroom through lectures that could illustrate numerically the future cost of water shortages. It also needs to be stressed that water issues are not related to a single generation but to several coming generations. In addition, some teachers called for realistic and practical techniques to raise awareness, such as field visits to observe the realities on the ground for example a visit to the providers of water services and organisations could enlighten students as to how things work within these institutions.

Furthermore, there should be a constant practical monitoring of the problems that are facing the kingdom and this approach can be used on any field trips or visits. To achieve this, teachers must take into account ages and educational levels of the students and also the type of the visit itself and what can be learned. For example, a visit to a desalination plant could demonstrate the Kingdom's dependence on desalination because of the scarcity of water or a visit could be arranged to a treatment plant for the recycling of sewage and waste water. With respect to the ages of students, teachers are of the opinion that students in the second three years (fourth, fifth and sixth levels) of primary schools are capable of learning from visits.

Motivation for research and additional activities outside the classroom

Teachers have also recommended that the curriculum should not always be the main focus and that students should have the opportunity to conduct their own research of water issues, This is particularly appropriate for High School students, which in addition to raising the students' own awareness will also improve their thinking and writing skills. Many teachers have claimed there has been no motivation or incentive for students to carry out research about water issues, the environment or pollution in the kingdom of Saudi Arabia. In fact this includes a lack of motivation to learn about the nature and causes of such problems in the wider Arab world.

Promoting awareness of the Rationalisation of water consumption

Some teachers have given an emphasis to water conservation, particularly in the stages of primary and intermediate school. They have shown that schools can play a role in raising the

level of their students' awareness of both water conservation and protecting water from pollution. They also believe that the Ministry of Education should show strong willpower in engendering a culture of the optimal practices for the rationalisation of water use. In addition, a creative approach is needed to promote awareness through engaging and creative methods.

This would mean a change in current styles of teaching and learning. A move away from the familiar style of auditory learning is necessary and instead a participatory approach will be required including the promotion of team work amongst the students. Through these methods, students can participate in their own learning and should be receptive to new ideas and challenges.

Practical activities and programs outside classes can also be an effective means of encouraging students to reduce excessive consumption of water, demonstrating the necessity for rationalisation through technical explanations. This could include the use of photographs, literature such as leaflets, brochures and booklets or auditory materials such as a CD that urges students to adopt water conservation. Also the demonstration to students of technical devices and tools for saving water, the establishment of a school system for checking and closing water taps, or checking water leakages can all help to clarify the full extent of the importance and the benefits of water conservation.

Accordingly, many teachers strongly believe that the Islamic religion will have a positive effect on the issue of water conservation. Islam in general encourages people not to waste anything, confirming the potential for religion to promote awareness. Thus, many teachers see their role as reminding students that extravagance in water use is not consistent in appreciating God's bounty. In addition, some teachers noted that the support of the Qu'ran and the Sunnah (Prophet's says and actions) could be used to remind students that there should be an increased possibility of being rewarded from Allah if they save water, in addition to being reminded that there should be a fear of God not to waste this blessing of water.

The process of raising awareness would not bring good results, except through linking it to deeds with which to seek Allah and as a fear of Allah from extravagance; also by

making comparisons between the availability of water and nonexistence of water through images because telling news is not like seeing with your own eyes and the picture is sufficient to avoid saying 1000 words. (Girls' primary school)

Other ways to raise awareness

Many teachers have made suggestions of how the education system could raise awareness through lectures, seminars, workshops and presentations within school. Also there is an opportunity for raising the students' awareness through the schools' morning broadcast in which important issues including water, should be discussed periodically.

Visual learning can play a part through posters and wall paintings that could send positive messages about water issues. In addition, there was also a suggestion that a group of students could form a working party and work with teachers to raise awareness. For example, in partnership with teachers, they could create a magazine each term about water issues and distribute them to their fellow students. These magazines could then be shared with students' families who could be encouraged to read them through strong messages to parents from the school administration.

Moreover, there were suggestions that teachers should take advantage of any issue or event related to water, such as disruption in water services or sudden leaks visible in the streets, which could be used to explain issues more clearly to students. Finally, teachers consider that a culture of reading should be established, in addition to the development of critical awareness, to encourage students to think analytically about problems and encourage them to develop a sense of responsibility about water issues in the Kingdom.

The education system will have a major role in raising awareness about water issues, if responsibility has been instilled among students, and students have been educated about the value of this wealth (the water) through the delivery of lectures, and the distribution of publications and the role of the morning broadcast inside schools. (Boys' high school)

The role of the media

The influence of the media has been discussed and the teachers conclude that awareness will increase if the education system in Saudi Arabia realises the importance of the role that it could play. In addition, media could play a part within schools through the presentation of lessons in the form of television, movies, educational films and the internet; to promote an environmental awareness which includes water awareness.

...there will be awareness if the education system is conscious and purposeful, and also if the raising of awareness could be done through public/general seminars and publications, television and internet; thus the society will produce the aware generations. (Girls' high school)

Suggestions for the implementation of World Water Day in schools

In the light of the lack of a consistent approach to World Water Day, teachers have made several suggestions that could ensure that schools engage with this event.

There could be an Open Day that would include innovative problem solving activities around water issues and the future of water provision, through which the results of waste and extravagance could be documented visually in pictures or movies, which could include the situation for the Arab world or even the whole world in order to demonstrate that water is a global concern. In addition, the open day should promote the involvement of parents through the distribution of appropriate information.

The morning broadcast could be used to introduce the issues of World Water Day and the first classes could involve the discussions of water conservation. The impact could be further increased through the organisation of a whole week of water, that could use morning broadcasts, lessons, lectures and extra curricula activities to promote messages of conservation.

By making World Water Day an official holiday in the Kingdom, and operating water awareness campaigns through media channels, including newspapers and magazines, a wider area could be exploited, including public facilities, markets and restaurants, streets and shopping malls.

Also a suggestion was made that there could be a competition to carry out field surveys in advance of World Water Day in order to target particular groups of consumers, or to reward the use of water saving devices in the home or schools. Prizes could be awarded for the least consumption of water and the results could be broadcast through media channels.

An arrangement could be put in place for a formal collaboration between the Ministry of Education and the Ministry of Water and Electricity to prepare a national programme for World Water Day. This could include distributing relevant information or providing incentives. In addition there could be flexibility as to when the activation of the programme was to take place.

Official actions from the Ministry of Education in advance of World Water Day could include sending letters to remind schools not only of this event but also of other international days that could promote the discussion of key global issues like water. The Ministry could also take advantage of the free SMS to notify the Saudi citizens by text message about World Water Day.

In addition, official action from the Ministry of Mosques (Masjedes) in Saudi Arabia could use the Friday Prayer speech to activate World Water Day through the Imams discussing water issues in all mosques in the Kingdom.

I suggest that there should be an official action by the Ministry of Education on this day such as sending official letters to remind people about that day (WW day) and other global days as well that discuss the important issues in the life for the whole of humanity. (Boys' intermediate school)

I suggest carrying out an integrated program for a week, beginning with advertising, the distribution of flyers, the allocation of suggestion boxes the organisation of a competition for the best logo or the best caricature sketch, and the allocation of the morning broadcast for a whole week, around the World Water Day. (Girls' intermediate school)

The influence of the current curriculum in raising awareness about water issues

Although information about Saudi curricula are available in general education publications, there are as yet no published views from individual teachers with regard to water issues and

how effective are the curricula in terms of the presentation of information and its relevance to the current Saudi situation. It should be noted that both boys and girls schools share the same curricula.

The replies to the questionnaires illustrate that almost the half of the teachers' sample believe that the influence of the current curriculum is weak in its promotion of water issues and does not approach the importance of the issue successfully, nor does it promote the raising of awareness of water issues. In addition, some teachers questioned how the impact of the current curriculum could be successfully measured, particularly with reference to saving water and any effect this might have on the behaviours of students inside and outside school. It does not necessarily follow that behaviours inside school will be consistent with behaviours in the family home. Regarding the limited Influence of the curriculum, some teachers believe that this is in part due to the absence of suitable messages that can be easily transmitted.

Teachers have also emphasised that some subjects or modules did not afford water its status not only as a crucial issue but also as a nerve centre of life. It is to this failure that teachers attribute extravagance and waste, leading to a culture of thoughtless and careless usage of water among many students.

An increase in awareness levels does currently exist in the learning in the current curricula. If there is any awareness, or the beginnings of awareness, it is through the teachers themselves. Participation in water issues comes from the concerns, the efforts and the suggestions of the schools and the teachers. (Girls primary school)

Availability of information about water

As we have seen, many teachers have confirmed that there is a low curriculum content with respect to water issues and information. Although there are examples where water problems are presented with accompanying advice, there is a lack of clarity and conviction in promoting students' understanding of the issues. To address this, there should be suitable, age appropriate methods for the different stages of study, in order to ensure that water topics are clear and easily understood. In addition, some teachers believe that the current information needs to be updated.

Elementary school teachers moreover, have a particular focus on the curriculums of the first three years of the primary school classes (first, second and third), but is generally perceived that curricula are not performing to a reasonable or satisfactory function. Although there are scattered examples consisting of phrases, or nonspecific expressions in the first three years that address water conservation, teachers are of the opinion that they do not fulfil their purpose. This indicates that the content is not sufficient to raise awareness.

The curriculum contributes very little, I am a teacher of the module of My Eternal Language (the Arabic language), the text book did not address the consumption of water or electricity, its topics (the book subjects), are not deeply discussed and do not benefit public daily life. (Girls' intermediate school)

The relation of the curriculum to the situation in Saudi Arabia.

Some teachers have noticed that the linkage of current curricula to the real life situation in Saudi Arabia is inadequate. As a result of this, there are students who do really comprehend the issues of water.

The curricula do not lead as such to this issue (the issue of raising awareness), and they (the curricula) do not benefit this issue, because almost of the curricula are literally translated and they are only marginally associated with the Saudi environment. (Boys' intermediate school)

On other hand, there are some teachers who consider that while there is a good impact overall for the current curriculum it is inadequate with respect to water issues because of insufficient attention. Those teachers highlighted some information and advice, including the Hadith ('the prophet says') and other verses, but on the whole they still believe that there is insufficient importance attributed to water issues. An exception was some examples of advice and instructions to lock water taps well after use.

In relation to the religious aspect of the curriculum, it has been said that there are examples around the issue of following (imitating) the Prophet Mohammed (peace be upon him) in his practices of water use, for example, explaining that the Prophet was carrying out ablutions by

using Meid, and that he was taking a shower by Sa'a (Mied and Sa'a are small containers, used in the past for weight).

Geographical aspects are inadequate however because there is insufficient attention to the nature of the Kingdom as an arid region with few natural water resources. Society is not encouraged to see water as a primary issue. Furthermore, the curricula that did present water issues, did so without significantly increasing the awareness of students about the risks, which placed the process of increasing awareness outside the curriculum and as the individual responsibility of teachers. In addition, the current curricula do not take into account the behaviours of students with respect to water. This should be investigated thoroughly to ensure that water issues do not remain on the margins of the curriculum, but are addressed as would benefit such an important issue.

The curriculum of learning does not fully raise awareness of water issues, because the current state of water needs to take an expanded role in the curriculum and not placed on the margins. (Boys' intermediate school).

Finally, several teachers presented the opposite view and claimed that the current curricula include many topics about water, and that its impact among students is positive. Some teachers have given examples of the modules and subjects that contain lessons that address water issues, such as how to rationalise water consumption or the overall importance of water. These modules include physics, chemistry and geography, English language and the National Education module (called AlttarbiahAlwattaniah in Arabic), religious subjects in higher and intermediate schools (Hadith, the Prophet's speech or his action, and Fegah, jurisprudence) and science modules (called Alouloom in Arabic) in primary and intermediate schools.

There is religious guidance and awareness especially in the religious modules (Hadith, Fegah/jurisprudence), also what should the student do toward what God has given of bounty including the blessing of water. Also for example, in the curriculum of Islamic jurisprudence in the first year of intermediate school, there are types of water, the water conservation and how to use water. (Girls' intermediate school)

The perception of teachers' enthusiasm for making schools play a role in raising the awareness of water issues in society

These responses demonstrated that the majority of the teachers' sample has a very high level of enthusiasm. Many teachers are optimistic that the reaction from the Saudi community will be positive and that students will benefit particularly if rationalisation campaigns would start in schools.

Reasons for this high enthusiasm: There were many aspects including the enabling of schools to raise community awareness; through teachers' responsibility as educators to promote the importance of water and its vital role in everyday life. Moreover, many teachers strongly believe that they should show motivation and enthusiasm for this topic because water presents one of the biggest problems faced by the Kingdom and it is present in every city. Teachers also express enthusiasm because they are Muslims and are aware of the importance of water; and its role in religious aspects such as ablution.

In addition to the religious aspect, there was discussion about the social issues. Some teachers expressed their anger about bad practices that they had seen in the streets, for example the sight of water flowing from houses and making a watercourse in the streets within the presidential areas. Based on these behaviours, many teachers believe that water is also a social issue and it should be the responsibility of every citizen to change his or her behaviours with respect to water.

Finally, many of the teachers realise that the current water scarcity and dependence on desalination in the Kingdom should inspire everyone to be passionate about water security, and anxious about the approaching dangers of water shortages in the region, with their associated impact on food security, energy and environmental issues.

The enthusiasm is 100% due to the importance of water for us and because the water sources in the Kingdom are limited and most regions depend on desalination projects.
(Girls primary school)

The degree of enthusiasm is very high, because the issue of water in the Kingdom threatens water and food security which are related to the issues of energy and the environment. (Boys' primary school)

Contrasting results: Some results have shown that there are a few teachers who have a regular or medium level of enthusiasm, because they are at present pessimistic about the potential for raising awareness, but it should be taught in an interesting way that includes incentives. It is however felt that any participation from the Ministry of Education and governmental organisations responsible for water services will not have the potential to be innovative in raising awareness due to the nature of the schools' communities. Finally, there is a very small percentage of teachers who do not show any enthusiasm or and concern about the topic.

Enthusiasm is in a medium level because the interaction and initiative from the Ministry of Education will be a slow process. (Girls' intermediate school)

The cultural aspects in the Kingdom of Saudi Arabia that can facilitate or complicate the raising of awareness

In this theme, teachers have emphasized how cultural aspects impact upon the awareness and concerns of citizens in Saudi Arabia. There were references to some cultural aspects that teachers feel will assist with raising awareness, in addition to other aspects that will make the process difficult.

The aspects that facilitate raising awareness

From the data, it can be concluded that religion is the most important cultural factor that can influence Saudi society. It can be described as one of the most conservative communities in the Muslim world, and every policy and action in the Kingdom is necessarily influenced by these religious aspects. Teachers have explained that religious influences in society are particularly effective because individuals must make a commitment to self-censorship in their actions through the fear of Allah. For example, in the issue of rationalising the use of water, we find the principles of Islam urge the conservation of water as the Prophet used to do. In effect, Saudi society is influenced by Islam in every way.

The religious aspect has the potential to facilitate any process of raising awareness. In this regard, some teachers noted that the process of raising public awareness in the Saudi population should be easier than in liberal, non-religious, and secular populations. In addition the Muslim community principles support positive voluntary work, which could be used by teachers to raise awareness outside the school environment.

In general, the majority of the teachers combine the education system in Saudi Arabia with the religious aspect. Many teachers discussed how important is the issue of combining water awareness with the Islamic religion. Thus, the Islamic optimal instructions, behaviours and practices have the potential to be the most important factors to facilitate a change in behaviours and practices of Saudi students. Overall, there are two relevant verses commonly cited by teachers, the first one showing the importance of water in life through the truth that there is no life without water; *Allah said 'from water we make everything living (alive)'*. The second ordering and educating people not to be extravagant (wasteful) in eating or drinking as a general principle in doing everything in this life; *'(Allah calls all people) eat and drink and do not waste (do not be extravagant or excessive), He (Allah) does not like the extravagant people'*.

Other aspects that could facilitate the process (as a number of teachers have demonstrated) are the use of technology, particularly the internet, and the devices of social communications that have become a feature of Saudi society. This could significantly enable the raising of awareness if used to its full potential.

Also, the increase and the spread of cultural competitions has become an important aspect in the various media outlets in Saudi Arabia. These contests offer valuable prizes, thus the exploitation of these competitions could greatly assist the process of raising awareness. Additionally, a programme of lectures in the cultural centres, such as the King Fahd cultural centre and the National Dialogue Centre in Riyadh, have become a common event, attracting many academics and teachers to these interactive gatherings, which can in turn be utilised in raising awareness.

The aspects that complicate raising awareness

Many teachers have raised the issue of a common practise in the Saudi community, namely the excessive use of water to clean hallways, large interior tiled spaces and automobiles. It appears that many of the rich Saudi families seem to care more than is average about cleaning and that they use water in almost all types of cleaning without any consideration for how much is used. Also, individuals within this demographic can waste water in the construction of swimming pools and in other leisure facilities which can remain unused for months at a time. One reason for this is that water bills in Saudi Arabia are inexpensive in comparison with other countries, and that these individuals can express the belief that money solves every problem regarding water issues. Therefore, these aspects create difficulties in raising awareness among a significant section of society, especially in their attitude to rationalisation and the culture of saving water.

Some teachers also pointed out a level of apathy including a lack of concern or a sense of responsibility towards the problems of society that exists within a minority of Saudi nationals and non-nationals. This is augmented by the free availability of clean and potable water in public facilities which makes it more difficult for individuals to understand the true cost of providing water.

Yes, the rich materialistic aspect of the Kingdom makes students and people feel that any problem could be solved by money, thus from this perspective there will be difficulty in raising awareness. (Boys' high school)

Yes, there are cultural aspects that make the issue of raising awareness easier in the Kingdom, for the Saudi society is a religious one, and it encourages voluntary work because there are sincere teachers, parents, employees and citizens who endeavour to do good things in every matter that benefits society for the sake of Allah. (Boys' primary school)

The most effective public awareness campaign on water issues

Teachers, therefore have made many suggestions that could apply to sub question four, how can public awareness be stimulated? To this end, teachers were asked whether they thought the most effective public campaigns would emanate from mosques, schools, water service providers or other government organisations. They could select any number of these options. Figure 31 demonstrates that the majority of teachers from sixty different schools believe that the most effective public awareness campaign on water issues would come from all of these organisations.

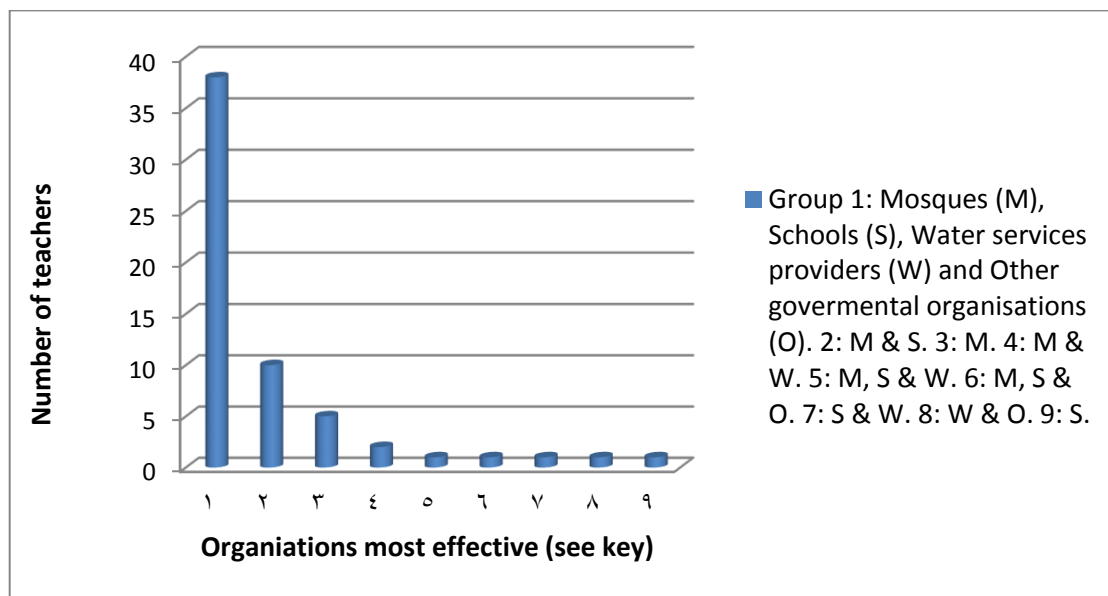


Figure 31: The most effective public awareness campaign on water issues – Teachers

4.3 The Water Managers', industrial managers', environmental managers', water engineers' and academics surveys

This second group will be comprised of water managers, industrial managers, water engineers, environmental engineers and academics, presenting a group of experts on water issues, who work both within the current water infrastructure; and also outside it such as in industry and academia.

4.3.1 Water managers' perceptions on the extent or scope for improving integrated urban water management (IUWM) in the KSA.

Returning to the research sub questions, a discussion will now follow centred on the potential for increasing and improving integrated urban water management with respect to how and to what extent this can stimulate public engagement.

The majority of water managers in the Ministry of Water and Electricity agree that there is scope for the further application of integrated urban water management in the Kingdom of Saudi Arabia. Also they are in agreement that the administrative process currently followed by the Ministry would assist with this process. This process, through the General Water Directorates for Water (water affairs) in each region (13 directorates at 13 provinces), includes branches in every city to undertake and supervise all water related issues.

In addition, most managers believe that privatisation in all areas in the near future will present the best case scenario for the water sector. The National Water Company will take full responsibility for the function of water services and the Ministry of Water and Electricity will maintain only a supervisory role. Moreover, the majority of managers believe that the optimal IUWM will be achieved only if there is participation between the water authorities and the project managers themselves.

Also some water managers see the participation of citizens is an important objective and that the public could participate in a range of different levels within water management. The participation of women is seen as particularly important in the field of water conservation practice. To enable this level of participation, many managers strongly believe that the Saudi water sector could benefit from the experiences of developed countries in relation to the application of IUWM to all water issues.

Yes, there is scope for further application of IUWM due to the short life of the Ministry of Water and Electricity and because of the need to secure the providence of water in the Kingdom. Before the establishment of the Ministry of Water and Electricity, water management was divided among several governmental agencies and ministries such as municipalities and the Ministry of Agriculture and Water (before*),

and the Water Authority. These organisations rarely worked together in coordinated and organised works, which led to a decline in the social and economic welfare of water services and also led to harming of water resources and the ecosystem'.(Ministry of Water and Electricity). (*Now it has become the ministry of Environment, Water & Agriculture).

On the other hand, there is a small number of the water managers who believe that there is no possibility at the present time for the successful application of integrated urban water management in cities and urban areas in the Kingdom. So far there have been no serious attempts to apply a concept such as IUWM. One reason is the existence of barriers to the application of integrated water management, where water consumers are not organised, particularly in the agricultural sector which is the largest consumer of groundwater. Also, water managers have noted that the consumption of water has been increasing and that groundwater is limited and it is expected to be depleted. Managers therefore believe that the agricultural sector needs to work seriously hard to raise economic returns for this growing sector which wastes water, adding to the amount consumed in cities and urban activities.

Levels of ground water are not fixed and this is both caused and controlled by several factors that delay the efficient organisation of water consumption. In addition, some managers believe that the kingdom did not fully embrace the principles of Dublin, especially with respect to the key role of women in water conservation.

In my opinion, it is still too early to apply the concept of integrated management of water resources in the Kingdom because the integrated water management depends mainly on the four principles of Dublin (1992):

- 1- Fresh water is a finite and vulnerable resource, essential to sustain life, social development and the environment.
- 2- Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.
- 3- Women play a central part in the provision, management and safeguarding of water.
- 4- Water has an economic value in all its competing uses and should be recognized as an economic good. (The MOWE)

In fact, the integrated water management generally did not apply the comprehensive and correct scientific forms in the Kingdom of Saudi Arabia.(The MOWE)

Water managers in the Saline Water Conversion Corporation (SWCC): Mostly they agree that the responsibility for the application and concept of the integrated management of water is only a part of the Ministry of Water and Electricity's responsibility, and that it is not a task or a function of the Saline Water Conversion Corporation (SWCC). Nevertheless among these water managers there are a few who have pointed out that there is evidence of the adoption of the concept of integrated and participatory management, which includes cooperation with other related organisations that have connections with water issues. Also SWCC works with several committees, composed of different organisations concerned with water affairs in order to discuss the need for water and to provide potable water to all cities and provinces of the Kingdom through the integrated strategic plan. This plan describes the needs of the population for drinking water until 2050 AD, and takes into account other related issues of desalination and purification plants.

Water managers' perception of the level of public awareness about water issues

Most water managers in the Ministry of Water and Electricity believe that public awareness, and attitudes and behaviour in relation to water issues in the Kingdom of Saudi Arabia are not consistent with a positive or an effective reaction to the country's water situation. In reference to research sub question two therefore, at this point water managers feel that significant public engagement will be unlikely. Also most of the managers recognise that current water awareness does not reach the desired or required level; and that in many cases the awareness is low. However, some managers believe that although there is some awareness, there is no sense of the coming risks that accompany the neglect of water issues, rendering this awareness as unsatisfactory, especially in practicing the rationalisation of the consumption of water.

Some managers, while accepting that there is some level of public consciousness among consumers (agricultural, domestic or industrial) towards water issues, particularly in the rationalisation of water consumption, but that the practices of non-national workers (non- Arab) in the Kingdom, especially with respect to domestic consumption indicate a lack of awareness about the water situation in Saudi Arabia. It is perceived that non-national workers are not concerned about water because they wrongly believe that Saudi people easily obtain as much

water as they need in their homes. This could be due to the fact that the majority of non-Arab foreign workers came from countries which have rivers and high levels of rainfall.

Awareness towards water issues in KSA can be described as needing a lot of work, with regards to public behaviours, this society is consuming large amounts of water, and not realising the vital importance of water, as a result we witness the unreasonable use of water in many places. (The MOWE)

Water managers in the SWCC: Similarly, the majority believe that that the level of public awareness is still at a low, even a negative level. On the other hand, some managers have observed that there is an increase in awareness, as a result of the desire of some citizens to repair leakage as quickly as possible and consequently, there is an absence of wastage through leaks in the home. Some managers have also noted a public trend towards the installation of devices that could assist with the rationalisation of water consumption, to the extent that people have been seen to advise each other as to the best practices to prevent water waste.

I would describe the awareness as apathy (lack of concern) and the feature of extravagance is common in the community. (SWCC)

The current water campaigns:

Some managers in MOWE indicate that in the year 2013 there have been efforts made to raise public awareness through major water campaigns undertaken by the MOWE in cooperation with the Ministry of Agriculture and with the Agricultural Development Fund. These campaigns are conducted under the supervision of the department of awareness and rationalisation of water consumption in the MOWE. Regarding the success of public awareness campaigns on water issues, almost half of the managers in the MOWE claimed that the campaigns were successful overall and that there were positive reactions in most sectors. A reason for this was the free distribution of water saving devices to citizens, governmental and civic organisations in the form of a 'water rationalisation bag or package'. The installation of some of these tools in public places gave an overall positive message because the public could see how they worked.

Some managers also indicated that during the previous campaigns, there were positive responses from elderly people aged fifty years and more that far exceeded younger people

under the age of thirty. Managers observed that older people valued water more than young people, which would have implications for the future success of campaigns. Moreover, it can be argued that the real reason behind the success of these campaigns is that they focus only on domestic consumption in a situation where this forms only a small percentage of the total consumption of water in the Kingdom of Saudi Arabia

On the other hand, some managers judged the success of the campaigns for all water users including agricultural, industrial and domestic users up to the year 2013 was not as the Ministry had expected. This lack of progress can be attributed to a particular period, where desalinated drinking water was still used to irrigate trees and in washing large floor surfaces. In addition, there is no consistent implementation for the necessary conditions and specifications when drilling wells for agriculture. Some farmers, it is argued, do not seek permits for the drilling of wells which has contributed to the disruption of secondary aquifers.

Additionally, there is an indication that the majority of people in some cities such as Jeddah, with respect to the rationalisation of water consumption, are instead demanding water and challenging the authorities to charge them. Some managers are convinced that such urban dwellers show no interest in campaigns for the reduction of water usage and wastage, but are concerned instead about how prevent the frequent interruptions to the water supply, especially in the summer time. Water is provided through the potable water supply network to households and it is perceived that these residents seek to avoid the traditional methods of obtaining water through the distribution stations where they would have to join a queue for the water truck. This situation encourages people to try to dig their own underground reservoirs.

The last awareness campaign was a great success which had not happened before (which included some mosques and public places, and some governmental organisation) and the benefits are continuing, amounting to a saving of water and economic costs ranging from 25 % to 40% in some places and organisations. (The MOWE)

The success of the public awareness campaigns on water issues is quite weak and limited, and the reason for this is due to the lack of awareness and the incomplete understanding of the severity of water problems on the one hand; and the ease of accessing water (in some areas) as well as the cheap price of water tariff on the other

hand. In addition to this, society has developed a habit based on extra consumption. (The MOWE)

For water managers in the SWCC, the majority of them deem that the both the current success and the future influence of the awareness campaigns were at an intermediate level, which is a slightly more optimistic response to sub question two. However, some managers have predicted a better outcome and confirmed that there have been good results for the rationalisation and saving of water in the mosques, hotels and government associations. Others however, maintain that the influence of the campaigns did not reach a sufficiently large number of citizens and householders.

The extent of current attempts or perceived role of attempts in raising awareness of water issues

All managers, whether in the MOWE or in SWCC have shown they believe current and past attempts to raise awareness of water issues are worthwhile. In fact many feel very strongly about this and demand that it must be better supported through more effective laws to regulate the uses of water in the kingdom. This is because stronger laws could influence behaviours that could inform a more positive culture about water awareness.

From their own knowledge, based on the aridity of the country and its dependence on the costly process of desalination, managers understand the necessity to raise the awareness of water issues in the community, especially with an ever increasing population and urban expansion. Moreover, some managers are optimistic about building co-operation between different levels of society to safeguard and protect the right of the future generations to water. Again, a positive response is shown to sub question two. Managers moreover, are beginning to take global issues of water awareness into account, where they strongly accept that truth that potable water has become a scarce commodity due to water shortages worldwide and the process of desertification.

Because water sources in the kingdom are limited, the demand is increasing and the competition on water resources is increasing at an unprecedented rate; and because water is the foundation of development and prosperity; the attempts to raise public awareness of water issues is a crucial national requirement and this need should not be compromised and it must be accomplished through a powerful political will. (Water manager)

Water managers' suggestions on how public awareness of water issues could be most effectively achieved

Turning to research sub question four: how can public engagement be stimulated, water managers have suggested a range of different responses. Firstly, most water managers believe that the implementation of the integrated management of water in all dimensions of its approaches, in all cities and villages of the kingdom of will bring about a corresponding improvement in public awareness, attitudes and behaviours. Therefore, public awareness and IUWM are co-dependent.

Also managers agree that in addition to public awareness, raising awareness is needed in all sectors, whether in agricultural, industrial or civic. As a comprehensive implementation of IUWM is not yet in place, managers suggested that public engagement could be stimulated through education around events such as Arab Water Week, the Arabian Golf Water Week, the Arab Day for Water (3 March) or World Water Day (22 March). The following methods to stimulate involvement and raise awareness were suggested as follows.

Promoting awareness through the education system

All of the water managers believe that water awareness campaigns should be targeted at schools, and that there should be a co-ordinated action to include raising awareness in the curricula. In this they are very much in agreement with the data from the teachers' survey. In addition, there will be a need for students to understand and experience water issues outside the classroom so that they can understand how these issues apply to everyday life; again there is agreement with the teachers here. Managers also agree that an understanding of water issues should be a fundamental right and that this should be implemented by the Ministry of Education in co-operation with the relevant authorities.

There were suggestions that an awareness campaign should operate at all school levels, but most water managers felt that the primary stage (the first three years) would be the most appropriate. They feel that this age group will be most successfully targeted as a responsible future generation. Again there is some agreement with the views of the teachers who saw the establishment of good practices at primary level as essential if this generation is not to suffer

from a water crisis themselves. Instead, the concept of saving water, the knowledge of the importance of water as a resource and the factors that influence it will be instilled in students in the Kingdom from an early age. Managers feel that such a campaign will produce good results in the long run, especially if combined with other activities such as small exhibitions and competitions within schools that could include making paintings or murals, perhaps alongside some lectures. Supporting this, field trips and practical visits could be arranged such as a visit to the MOWE for students in Riyadh or visiting the general water directorates in other cities. They could include observing the various water projects or visiting desalination, purification and treatment plants or dams. Furthermore, some managers believe that work could be done to introduce some programs and electronic games that could raise awareness about the importance of water for children. From this data, it seems evident that water managers are ready to co-operate with teachers and offer integrated initiatives.

The issue of embedding awareness in the curricula: Managers had noticed that schools curricula generally included some references to water issues, but were of the impression that this did not go far enough to effectively embed awareness about social and environmental issues that would include water, contrary to what the Ministry for Education may believe. Some managers saw the need for a module that would cover excess consumption in water and electricity. They also made some suggestions such as adding some information to the book of National Education and encouraging co-operation between the MOWE and the Ministry of Education to work together to promote a culture of smart, friendly environmental practises, to reduce both water and electricity consumption.

Continuity during intensive and concentrated campaigns: There has been a suggestion to make schools campaigns intensive and regularly prepared and updated for each academic year. Some managers believe that the continuity of learning that students will experience is not only essential to embed their knowledge of water issues, but will also gain an understanding of the potentially critical situation of water in the country.

The attempt to instil the concept of conservation and protection of water resources for young people is the ideal choice but this choice will not produce good results straight away; it will take some time to see good results. (MOWE)

Attempts to access to all segments of society

There were indications that managers saw the importance of co-ordinating different government agencies, institutions and organisations in order to engage as many segments of society as possible, thus using all possible means to enable the largest possible number of people to understand water issues. This could be accomplished through media outlets such as broadcasting, where specialists in the field of environmental issues could prepare programs, or advertising channels could be used through print or television. Social media could also play an important part through the promotion of Face book or Twitter campaigns.

The majority of water managers suggest that these campaigns must be accessible to all levels of society and differentiated accordingly to different levels of knowledge and education. They explained that this diversity would need to be planned throughout the campaigns, from educational communication through to public forums, exhibitions and competitions.

Methods to demonstrate the current water conditions

Offering realistic and transparent information about the water condition: Many managers warned that there was a need to be cautious when addressing Saudi society about the realities of water issues and the possible serious consequences of current practices however at the same time it was essential to make the community aware that there are no renewable sources for water in the Kingdom.

Linking awareness to the Islamic religion: Again, there was agreement with the results of the teachers' data in that warnings about water use, in particular excessive use, could be linked to religion. A large number of managers believe that the Imams (speakers who deliver speech every Friday prayer at mosque) should be urged to remind the people of some of the Islamic instructions and information that are related to water issues, and that this initiative could be co-ordinated between the MOWE with the Ministry of Islamic affairs

Focusing awareness on three kinds of consumers

The Labour force: Many managers have drawn attention to the large, non-national labour force in Saudi Arabia. There are a total of eight million foreign workers in the Kingdom and managers have identified that they also need to be better informed about water issues in the Kingdom. They believe that this especially applies to non-Arab workers from Asian countries as their environment is completely different to the arid conditions of the Kingdom. Managers have suggested that workers need to be instructed upon arrival to the country by their employer or sponsor, in addition to direct supervision in the workplace where guidance could be given about specific tasks such as irrigation or washing.

The Major agricultural consumers: Managers have expressed concern about the depletion of Aquifers due to excessive usage from bigger consumers such as agricultural companies. The depletion is caused by planting crops that require a large amount of water and also to dairy farms, which require vast quantities of water. Managers have explained that there is a need to convince the agricultural sector to conserve water through improving their level of awareness and encouraging good practices in irrigation which could save water. In addition, there should be awareness programs for farmers that could show percentages which could be saved by rationalising water consumption. In addition, farmers and investors should avoid the export market, particularly in the case of dairy farms and concentrate instead on local needs.

Women: women had been identified as an essential target group by the Dublin initiative, because women as home workers have a unique role in the practice and promotion of water conservation. Many managers agree that there should be more focus on women who could share good practice in the home. This could be done in partnership with the Ministry of Social Affairs.

The attempt to develop patterns of agriculture and irrigation, and the preparation of learning programs for farmers is one of the best means to deliver the idea that the water sources in the Kingdom are scarce and should be wisely dealt with. (The MOWE)

Learning from the experience of other of countries

The majority of managers pointed out that learning from the experience of other developed countries who have made progress in the field of awareness could prove very important in the of formation successful campaigns. Some managers cited the UK, America, Japan, and Australia, and also African countries.

Raising the cost of water tariffs:

Some managers, especially from the Saline Water Conversion Corporation, (SWCC) share a common views about the need to readjust water tariffs in KSA, even some went further and suggested that the water tariff should be increased. It should follow that higher tariffs for higher levels of consumption would provide an incentive for improved conservation practices.

It can improve the awareness and behaviours to prepare for awareness and education programs and establish forums to reconsider pricing water. (The MOWE)

Public participation and the national action plan via MOWE

Many water managers at MOWE support the need for public participation in the water sector, and believe that there should be attention to consumers' views, especially in the situation of water services. Managers explained that currently the International Monetary Fund is preparing a study to develop an integrated strategy to run all water resources in the K.S.A. The first stage of planning work has been completed and work on the second phase is underway. Significantly, public awareness and participation are included in the national action plan, and it is believed to be proceeding well.

In addition, managers confirmed that public awareness will be a key component of Saudi Arabia's own strategy, which, at the time of writing, is still under preparation and not yet approved. During workshops conducted for the preparation of the plan, some managers felt that representatives from the agricultural sector already had some idea of what should be done in their field. Managers have seen this as an optimistic sign that there will be a corresponding

increase in awareness from different sectors when the strategy is finally approved and implemented.

Water managers' perceptions of the need to create a committee to manage the promotion of water conservation awareness

The majority of managers in the MOWE do not see the need to create a committee to manage the awareness and promotion of water conservation. Such a committee would involve water professionals and experts, water engineers and planners, environmental engineers, social marketers and education professionals. A number of managers have explained their reasoning for not accepting the committee formation. One reason is that the MOWE General Administration has its own specialists, who have the ability themselves to achieve the goals of raising awareness. In addition National Water Company (NWC) has its own marketing department, which water managers believe will be well able to promote the process of raising awareness particularly with respect to conservation. However, some managers see the benefit in communicating with experts in different fields and disciplines such as teachers and other educational professionals.

In contrast, a few of managers recommend the establishment of regional organisations rather than one national committee. These regional committees should be provided with all necessary resources including documentaries about water issues. Managers would prefer them to be regulated and operated by the General Administration for awareness and rationalisation within the MOWE. Also, managers who support the formation of committees would prefer it if they monitored water consumption rates in addition to raising awareness. Significantly, some managers see the importance of including some religious and also an element of social input into these proposed regional committees, perhaps including arts workers.

The SWCC managers however, were for the most part in support of forming an over-arching committee of experts. The managers expressed support of team work and suggested that there should be a team led by the MOWE with the membership of other relevant ministries such as

the Ministry of Education and the Ministry of Culture and Information who should work together to form the committee. The role of the committee could be decided upon through a programme of workshops and brainstorms to format initiatives and plans that could be applied to a programme of raising awareness.

I do not support the creation of a Committee to manage the process of raising awareness in society to save water; because I believe that specialists in the MOWE have the ability to achieve the required targets, but in limited cases there is a possibility of bringing in other disciplines. (The MOWE)

The extent of water managers' cooperation (MOWE/SWCC) with important governmental organizations and external programs or organisations

Cooperation with the Ministry of Culture and Information

To some extent, the water managers support a multi-agency role in order to stimulate public engagement. The responses from the surveys that came from MOWE were aware that there is useful cooperation with the Ministry of Culture about Information to raise awareness about water issues but some managers agree that it does not reach the required level. Some of the Managers' Surveys indicated that the planning department at the MOWE has collaborated with the media through publication in newspapers and imparting information between television programmes. A few managers however are completely unaware about a history of co-operation between the MOWE and the Ministry of Culture and Information. Also, the surveys demonstrated that in the department that deals with the digging of wells, there are moves being made to guide citizens in their application for drilling permits so that they will be aware of the best ways to preserve water from depletion or pollution. The department is also giving approval to citizens who can protect aquifers through correct drilling.

In relation to the SWCC cooperation with the Ministry of Culture and Information: the surveys have shown that the water managers agree that it is not the responsibility of the SWCC to cooperate with the Ministry of Culture and Information but is instead a role for the MOWE.

Co-operation with the global agents in the water field:
With regard to the MOWE: cooperation with the global agents such as *the Global Water*

Partnership, The World Water Council, The International Water Association, The International Water Resources Association, The International Desalination Association and the Water Quality Association, it has been noted that most of the water managers perceive that the Ministry does not in fact work and cooperate closely enough with those international organisations, and that any collaboration is still at a very low level. This lack of co-operation also extends to Ministers and specialists working individually.

Likewise, the majority of the managers in the SWCC agreed that co-operation with these global agents is not even close to a good level. However, the managers have provided some information in relation to the issues of water desalination, in that the SWCC participates in global conferences that are focus on desalination by submitting relevant scientific papers, including the publication of SWCC experience in the fields of design, implementation, operation and maintenance of desalination and power plants. These papers also included methods of improving production and reducing costs. Moreover, the surveys show that the SWCC occasionally organises workshops involving experts from the SWCC itself and of several professors from Saudi universities, who are interested in water desalination, in particular alternative desalination methods, to support and encourage new technologies that contribute to lowering the overall cost of the process.

Cooperation with international water projects and programs:

The questionnaires' answers principally confirmed the collaboration of MOWE and SWCC with the following international water programs and projects: the International Hydrological Programme (IHP) (via the UNESCO), the World Water Assessment Program (WWAP) and World Water Development Report (WWDR), is very limited.

Water managers' suggestions for how to improve communication and cooperation between consumers and private companies.

Consumers' communication with the National Water Company (NWC): Managers have stated in their responses to the surveys that the MOWE (as a governmental organisation that supervises upon the water sector with its partners) encourages the NWC to improve the effectiveness of its communication with consumers in relation to water awareness. Some surveys discussed the importance of delivering messages to customers that would urge them to communicate with the NWC when needed, in the events of leaks and other water wastage

in order to facilitate and speed up its responses to problem solving. In addition, the NWC has begun to show professionalism in marketing and dealing with consumers. There are questionnaires that give a good impression of customer services in the NWC.

Communication with bottled drinking water companies:

Most surveys showed that the current collaboration level between private bottled drinking water companies and the MOWE is currently at a low level, due to the fact that many managers have not taken private companies into account with regard to water awareness.

Overall, the water managers agree that there is scope for increased co-operation and partnerships with different organisations, although as yet this collaboration is limited. To return to the research sub questions, the managers see opportunities for ways in which public engagement can be stimulated through a range of the different approaches that partnerships, both national and global can offer. In addition, they are broadly in agreement with teachers in identifying partnerships at the religious and education level both to stimulate engagement and to maximise the potential of this engagement.

4.3.2 Analysis of the Industrial managers' surveys

Having looked at the data from SWCC and MOWE, the next managerial subgroup to be addressed will be the industrial managers, who will have a very different level of interest in water issues than the first group. Data has been gathered from Saudi Aramco and SABIC. Saudi Aramco (Aramco: Arabian American Oil Co.) is seen as the world's foremost company. Saudi Aramco operates the world's largest single hydrocarbon network, producing the largest daily oil production. SABIC (Saudi Basic Industries Corporation) is the largest non-oil company in the Middle East and one of the world's ten largest petrochemicals manufacturers.

Perceptions of the company's awareness, attitudes and behaviours in relation to water issues in KSA

Aramco: The industrial managers in Aramco described that the company's attitudes in relation to water issues as excellent, in which (managers say) the company introduces modern methods to manage and to solve water problems in the industrial fields and in the residential areas of

the industrial cities. Also managers stated that the company uses several techniques to take advantage of the used water, in fact it could be argued that they attempt to maximise this usage in general. Some managers have commented on Aramco's cooperation with the MARAFIQ company, (Marafiq: Power and Water Utility Company for Jubail and Yanbu, the Running Water & Power for Life, and the First Utility Company in Saudi Arabia which supplies water and electricity to the cities of Jubail and Yanbu –the two industrial cities in KSA), regarding the growth of the water demand. On the subject of water conservation in terms of *rationalizing water consumption*, the company educates their employees about the importance of saving water.

The awareness, attitudes and behaviours is different from one person to another and from one nationality to another , in which we find a few Saudi employees who really care about the rationalisation of water consumption, and spread awareness in this regard, we also find that a lot of Asian nationalities, such as Indians and Pakistanis and Bangladeshis overusing water.(Aramco).

SABIC: Likewise, most of the industrial managers have described the awareness of water issues in SABIC as very good, however, some have shown that despite this, it could benefit from more actions and initiatives. Despite this, there are efforts in place to raise the awareness and responsibility towards water issues such as conserving water and in the main; these efforts are achieving the required results.

Also some of managers made the point that for SABIC, water use is an essential part of their industrial processes, and as a result, SABIC considers the topic of the water management a key factor in terms of manufacturing costs and of consuming natural resources. For this reason, the company adopts sustainability programmes. These programmes have made great progress, and they managers believe that they have contributed to reducing costs and conserving natural resources.

The company has some important projects which contribute to raising awareness of the importance of the water issues and problems; and SABIC has applied and adopted some important initiatives in the field of sustainability, and for the sustainability of water in particular, such as the project of sewage and wastewater management, and the project of managing potable water inside the SABIC. (SABIC)

I can conclude that the awareness of water issues in our company (SABIC) is very good. (SABIC).

Managers feelings about the perceived role of Saudi Aramco and SABIC in raising awareness

The data from the industrial managers has so far been positive with respect to sub questions three and four; how and to what extent can public participation be stimulated and to this end they have established their own programmes for raising awareness amongst their employees. It could be argued that this success is in part due to the need to reduce manufacturing costs and that therefore these companies have a vested interest in water conservation.

Aramco: The Company surveys expressed a collective wish to participate in social awareness programmes via public competitions and distributing literature. In relation to the industrial field, actions are taken very seriously. Aramco, according to its managers, has the ability to use the newest techniques for rationalising water consumption and to support water saving behaviours that apply both to individuals and to industrial consumption. Also, some industrial directors have shown that Aramco is enthusiastic about promoting scientific conferences that cover water issues.

SABIC: The surveys show that the SABIC administration could raise awareness through targeting its own employees and promoting its community programmes, as part of the company's commitment to social responsibility. Some directors are enthusiastic about working outside the company and agree with the MOWE and SWCC managers in the value of targeting schools at all educational levels. Again, this proposed partnership with education is becoming a consistent factor in the data. In support of this, managers strongly believe that the company has sufficient abilities and resources to support projects and innovations in water management throughout the Kingdom of Saudi Arabia.

Opinions about the extent of current attempts in raising awareness of water issues

Aramco: The Aramco managers feel that current efforts to raise public awareness of water issues have been worthwhile, but they also confirmed that there was still evidence of too many

negative behaviours, which indicated that levels of awareness remain at a low level in the Kingdom. In this regard, they perceive that larger companies have a vital role in promoting awareness that they must perform in the community in order to fulfil their commitment to social responsibility.

Some managers also observed that practices of overuse are not solely restricted to water, but can be evident in people's behaviours in the wider social sphere. Accordingly, they feel that a sense of responsibility must be encouraged and promoted so that the public begin to understand that excess consumption will lead to the depletion of natural resources and cause future generations to suffer. Some managers also expressed an opinion that levels of awareness were more apparent in more developed communities and felt that advances in modernity would also bring about a corresponding increase in levels of awareness.

I see that the issue of raising awareness about water issues is very important, not only in terms of Islamic or social aspects, but also in all respects. (Aramco)

SABIC: Managers in SABIC likewise feel that efforts to raise public awareness of water issues are worthwhile, due to the importance and scarcity of water resources, the growing problem of water pollution and the presence of negative behaviours in wasting water. Incidentally, this group view the status of water security as priority for the Saudi leadership because of association with food security in the Kingdom, particularly the maintenance of an internal food supply. It is important that current campaigns have a positive impact in behaviour in addition to awareness.

I see that the efforts to raise public awareness of water issues are particularly worthwhile especially because we live in a desert and all of us know the importance of water and its role in our life; so water is the most important thing and the nerve of life.(SABIC)

Suggestions for how current awareness, attitudes and behaviour around water issues could be enhanced by campaigns

With respect to the campaigns by both companies (Saudi Aramco and SABIC), most managers believe that water awareness and its accompanying benefits of conservation and improved behaviours, could be easily improved by utilising the organisational structures within the two companies, which would assist with the effective distribution of tasks. In relation to the importance of public campaigns, all managers confirmed that the campaigns were of high importance because of their impact in changing the community through the process of changing the behaviours of individuals. Managers felt that any increase in water awareness would be met by an accompanying decrease in environmental problems.

Campaigns could be improved however, through a longer term targeting of the following areas: the production methods used to extract water, methods of water consumption, the current situation and its effects on the future. Also some managers noted that the Saudi sector could benefit from sharing experiences with other arid countries that need to address water awareness in their strategies.

Industrial managers' views and perceptions of the meaning of IUWM

The majority of managers in the Aramco and SABIC companies understand IUWM to mean the integrated process that can take advantage of all natural and industrial water resources through managing these resources optimally. In addition IUWM is about recycling in the form of reusing water and other methods and takes into account the management of both consumption and consumer. Others managers view IUWM as a strategy that concerns water in all respects, and must consider all approaches to water management, including the management of water resources, the management of sewage and the management of water treatment for wells-water and rainwater, to order to achieve optimal results for the available resources of water.

Additionally, a few managers explained IUWM as a process to make government and citizens work together to conserve water, reduce waste and accordingly be able to raise awareness. In this way, it can be seen that IUWM could be the key to sub questions five and six: to what extent

and how can public engagement be harnessed? A positive impact on behaviours would demonstrate how this awareness can be harnessed and transferred to actions.

Understandings of the extent of IUWM in KSA

Questionnaires from the two companies revealed that most managers believe that IUWM is practiced well only in the industrial cities. Even in this case, however, there is no integration of management roles for the water services in other Saudi cities and urban areas, but instead a reduction in water services, leading to an inconsistent approach across the Kingdom. Although, some managers see that efforts are made to ensure that water management is of a high quality, they do not feel that these efforts are effective.

This inconsistency leads to problems in systems for the infrastructure, which affects the networks of drinking water provision, of irrigation and of drainage systems. Accordingly, the majority of managers believe that the current situation can be improved by taking on board projects and ideas for achieving integrated water management.

In the industrial cities IUWM is practiced effectively, but regarding the other cities I do not expect that the percentage of practice is high, where there is a water crisis in some cities.(Armco)

I do not see it (IUWM) is practiced properly as required to be, however, there were some attempts; and it can be improved when there is a comprehensive and integrated vision among decision makers and stakeholders towards achieving integrated water management. (SABIC)

Managers' perceptions of barriers and challenges to the implementation of IUWM in the near future.

Although this group of managers are aware of the potential of working with different partnerships, with respect to the means by which public engagement can be stimulated, they are less sure that there is an adequate infrastructure in place as yet. Ideally this infrastructure would be some form of IUWM, as the industrial managers in a previous section had expressed

their belief that IUWM will bring about a proportional increase in water awareness and an accompanying change in behaviours that would demonstrate an effective harnessing and use of this awareness, as in sub questions five and six. This will not be an option just yet, however. The replies to the questionnaires brought out several obstacles or challenges that could face the application of IUWM in the Kingdom as follows:

- The lack of having sufficient awareness of the importance of water issues which led to the continuation of negative habits among a large percentage of the general public. Also this includes the use of water among a large number of citizens who are not taking seriously the discussions about the water issues.
- The ability of reducing the wastage of water for many agricultural users (such as having increased irrigation rates) as well as for domestic users (such as the excessive use of water in cleaning vehicles etc.). In addition, there is the issue of how to instil positive public behaviours towards water.
- Incomplete infrastructure for the transportation, distribution and drainage network of water in the Kingdom generally.
- Lack of the realisation of the importance of integrated and organised management for water issues, both at the individual level and at the organisational level.
- The difficulty of obtaining new water sources and the adequate modern methods to take advantage of the seasonal rainfall.

The first obstacle: not having enough awareness and understanding either by individuals or by the organizations that are related to the water issues. Secondly, the infrastructure is an obstacle; it must reach an advanced level to be able to accommodate the implementation of integrated water management. (Armco)

One of the most important obstacles and challenges, that may face the application of integrated water management in the Kingdom of Saudi Arabia, is the scarcity of water in general, and the lack of general awareness of the importance of integrated management in sectors related to water; and also the lack of having adequate laws and regulations relating to water issues. (SABIC)

4.3.3 Environmental Managers and Water Engineers

Environmental managers' and Engineers' understandings of the meaning of IUWM

The industrial managers had more or less concluded that IUWM was the best solution to raising awareness and promoting good practice, but they did not feel that it could be successfully implemented at this stage. In effect, without a consistent implementation of IUWM, there could be no solution to sub question five and six, how and to what extent can public engagement be harnessed; in this case harnessed in the promotion of good practices.

The discussion will now move to the next groups of managers, the engineers in the National Water Company (NWC) who, through their responses to the questionnaires, have presented their own understanding of IUWM, explaining what the approach of the integrated urban water management (IUWM) would mean for them. These ideas ranged from better decision making in the use of water, the consideration of water resources as a source of life and also the economic importance of water with respect to urban and civil development and prosperity.

Some NWC engineers have a strong understanding of IUWM as a process encompassing the entire water cycle, beginning with water at its source, including different public uses and ending with the disposal of treated used water back to the source, or back to urban use. This is an expression of IUWM as the urban water cycle as discussed in chapter two above.

In addition to this urban cycle, a more effective tracking of water uses and demand through IUWM could mean that effective predictions could be made to determine future water need as there is no overarching system of IUWM in place, the process can mean different things to different groups or individuals. The environmental managers from the Ministry of Agriculture and the Presidency of Meteorology and Environment explained that for them, IUWM means a process of dealing carefully with all stages of providing water to consumers. These stages include the desalination plants, purification plants, water supply networks and the quality of these networks, ground reservoirs and sewage and waste water treatment. Although there is a slightly different emphasis in this definition, it is another representation of a holistic urban water cycle. Although there is not yet a consistent plan in place, there is a general understanding

among these stakeholders that IUWM is a process that takes into account all major aspects of the economic, social and environmental issues of water provision.

IUWM also requires co-ordination between the water and other related authorities, in order to secure sufficient water to meet demand and guarantee that all related services will be provided at the right time and by the best methods. Some managers see this necessarily accurate co-operation between managers as IUWM's main difference to other systems of water provision, because not only can it better meet needs, but also IUWM embodies an on-going rationalisation process with respect to water consumption.

IUWM is the procedure of dealing with high awareness during all the stages of water production from the source until the optimal use and exploitation of the water from all of the aspects of economic, social, environmental uses; and it (IUWM) means assuring the sustainability of supplying healthy water.(The Ministry of Agriculture)

It (IUWM) is a mechanism to deal with the wealth of water from the phase of extraction from its basic sources and the processes of production and preparation of the water for different purposes into accessing the recycling and re-use of the used water in an integrated environmental circle.(The Presidency of Meteorology & Environment.)

Perceptions of the true extent of IUWM in practice

Engineers in the National Water Company perceive (like the Aramco engineers) that although IUWM is practiced in some larger cities, it is not practiced as well as it should be to enable all the necessary applications of IUWM to be effective. For the NWA engineers, the management of the water sector in the Kingdom has not yet reached a good enough standard, despite the provision of adequate government funding. They feel that water management in general does not have enough staff of a sufficiently high professional standard to correctly implement an integrated water management approach. More importantly the NWC engineers have listed the following points (summarised below) that they believe will improve the overall practice of IUWM as follows:

- Work rapidly to achieve the completion of sewage and drainage networks with all the necessary requirements for both cities and villages in the Kingdom.

- Carry our scientific research to gain a full knowledge including geographic locations of all water resources in the Kingdom for the next 100 years to come, and use this knowledge to make strategies and long term plans.
- Fully reuse all used water for agriculture, industry and domestic use (the full exploitation of grey water).
- Control and adjust the fair distribution of desalinated water to all regions of the Kingdom; and put in place necessary regulations and legislation.
- Continue to research how to maximise the benefit from rain either by building more dams or by other methods of harvesting rain.
- Improve the structure of the water sector itself and take advantage of the expertise from developed countries and invest in the building of more research centres and institutes.
- Readjust water consumption, (measured either in gallons, or cubic metre, or Saudi riyal) to balance the consumption of all major users (residential, commercial, industrial or governmental establishments so that none are exempted from the tariff).
- Encourage the private sector to involve water managers and view them as partners and consumers at the same time.

Environmental managers in the Ministry Of Agriculture and the PME believe that IUWM has become an urgent necessity, dictated to us by the current water situation in the Kingdom. They believe that responsibility is heavily on the Ministry of Water and Electricity, where IUWM is not felt to be efficiently practiced or applied. Managers also think that there are no standards and criteria that can be applied accurately to measure the success of the current exploitation of water resources in a country suffering from water scarcity problems. Other managers explained (like the NWC) that the level of success of the current water management water is disproportionate to their high level of governmental subsidy where there is still a noticeable lack of water services in some of the residential areas. They also point to a lack of maintenance of the infrastructure, which leads to water disruption in urban areas.

Thus, environmental managers in this subgroup have made their own suggestions as to how the application of IUWM can be improved as following:

- Enacting more laws and regulations in relation to IUWM - Planning for the future and benefiting from the experiences of other countries in water management - increasing awareness of citizens in general and focusing on educating farmers and the workforce particularly the agricultural workers - Increasing accountability of the negligent managers in the application of laws and regulations relating to IUWM and giving incentives to those who are following the rules – Carry out more maintenance work regularly without delay - Provide water services equally in all of cities of the Kingdom - Increase fully trained professional employees in the water management field – Initiate exhibitions in Cities, and work in cooperation with the MOWE, with the Ministry of General Education and with Saudi sport clubs in order to improve public awareness.

I think it (IUWM) is not applied in the required form, where there is a notable lack of water services in some of the residential areas with no regular maintenance of water pipes in some areas, and that can be improve by frequent maintenance and by providing water services in every region equally.(the PME)

Discussion of barriers and challenges that might impact on the implementation of IUWM with ideas about how they could be overcome.

The data from environmental managers suggests that they see two sets of barriers that might obstruct the application of IUWM. One of these is environmental and the other, institutional and managerial.

For NWC Engineers, the institutional and managerial issue is the most significant. Their questionnaires revealed that for them the most significant challenge to the effective implantation of IUWM is the current level of bureaucracy within water management. Again, the engineers have issues with the role of water managers. Some engineers spoke about the presence of some old mindsets that they perceive as still having influence in some fields of the water sector, applying what this cohort of engineers believe to be out-dated concepts of water management, leading to delays both in the implementation of IUWM and in utilising recent technological developments which could improve the current situation. In addition, it has been stated that there is a need to recognise the importance and potential of a genuinely integrated management that could enable communication on environmental matters with the Ministry of Water and Electricity.

In order to overcome the barrier of bureaucracy, some engineers have recommended that a separate and independent board should be formed from the MOWE, the Ministry of Commerce and Industry, the Ministry of Agriculture, the Presidency of Meteorology and the Environment, the Ministry of Municipal and Rural Affairs and the Ministry of Economy and Planning. This new committee would consider water as an important strategic force. To this end it is proposed that this new, independent board could acquire the legal means to make their participatory decisions enforceable. In relation to IUWM implementation, some engineers view as inadequate feedback from both the Bureau of Experts at the Council of Ministers and the Committee on Water and Public Facilities and Services. Moreover, engineers claimed that the application of the principles of *Value Engineering* could overcome the obstacles related to the overdue water projects.

For the most part of what causes difficulties (in the application of IUWM) are some of the mind sets that manage some issues in the water sector, where they are still following old concepts which might delay the application of IUWM and also might not be applicable to modern and current developments.(the National Water Company)

Challenges related to overcoming the institutional and managerial barriers: To summarise, these following issues have yet to find a solution. Both institutional and environmental barriers will be outlined in the section following, but we will begin with institutional and managerial issues. A summary of important issues follows:

- The lack of specialists in the institutions that deal with water in KSA.
- The weakness in the abilities and skills of staff members in integrated water management and the lack of support and training from human resources.
- The presence of uninformed workers complicates integrated water management of water in terms of raising awareness.
- The lack of accuracy in some water studies that should clarify future growth in demand.
- The existence of multiple governmental organisations in managing water so coherent planning is made impossible.

- The awareness campaigns were not really effective, because they failed to reach large sections of the community who consequently do not have the required awareness about the rationalization of water use.

Challenges related to the environmental dimensions:

- Scarcity of water because the Kingdom is an arid region and there are long distances from the sea for some of the 13 Saudi provinces.
- The inhospitable geographical nature of the deserts and the mountain areas. The sloping land in the South-western region of the kingdom also impedes the process of delivering desalinated water.
- The amount of environmental pollution resulting from the desalination of saline water, leading to financial and environmental burdens.

For both the environmental and administrative issues, managers believe that they can be addressed by careful long term planning that will take into account population growth and urban projects and industrial projects. This comprehensive planning should be able to determine a range of solutions for the above issues, adjust the current status and anticipate and prevent problems. Significantly, the plans take into account the promotion of public water awareness. This brings us back to IUWM as the only system that can address the issues in the sub research questions and harness an improved and stimulated public engagement in the practice of good behaviours, with respect to water conservation,

Perceptions of public awareness, attitudes and behaviours in relation to water issues.

The majority of engineers have described public awareness, attitudes and behaviours in relation to water issues in Saudi Arabia as weak. In the previous section, it was stated that they felt that current campaigns failed to reach large sections of the public. To address this, they envision a shared responsibility between the consumer and the water sector administration.

For the consumer, his or her goal is to obtain water, but some consumers do not conserve it but view it as a possession to use in whatever way they choose, without taking the true cost

into consideration. On the other hand, the water sector has not as yet put into place effective programs of raising public awareness which should be one of their most important roles. However, engineers have judged that there is a need for serious action from water policy-makers.

However, although there is a governmental drive to ensure water security, environmental managers see that public awareness is weak and that behaviours and attitudes are not satisfactory. There is a lack of focus on educating citizens and inadequate use of the media. Where media has been used to raise awareness, its effects have been temporary. There were a few managers who believed that public attitudes are good, but this was not the majority view.

Managers believe that in order to quickly and effectively improve public awareness and attitudes, laws and regulations should be put in place with sanctions that must be stringently enforced. Managers believe that sanctions are required in order to enforce good practices that will eventually, through familiarity, become part of the social fabric. Sanctions alone are insufficient however, as good behaviours are fundamentally based on knowledge and awareness. An effective campaign requires clear determining goals accompanied by effective explanations. Most importantly, they should work in partnership with other organisations such as educational, artistic, technical and media groups.

Water Engineers' ideas on the need to create a committee to manage the promotion of water conservation awareness

All responses from the engineers' surveys strongly advocate the notion of establishing a managing committee that would involve water planners, social marketing and education experts, water professionals and environmental engineers to manage the promotion of water conservation within society. Further in support of the committee, engineers pointed out that there should be a productive exchange of knowledge and experience between its members. Some engineers suggested the formation of regional committees, perhaps forming a committee for each city and then engaging other related organisations. These could include the MOWE, the Saudi Water association and the Saudi Council of engineers.

Managers in the Ministry of Agriculture also agreed that it would be useful to form such form a management committee to promote awareness and conservation. Moreover, they advocate this committee should be formed of groups who are beneficiaries of water, whether in the agricultural, or industrial or domestic sector. Other ideas suggested that members of the committee should be formed from governmental organisations in order to give each member the opportunity to represent his area and therefore taking personal responsibility of any related task.

Managers in the Presidency for Meteorology and the Environment were mostly in support of a committee, but felt that it should be totally under the supervision of the MOWE. Additionally, some managers advocated sub-committees and a general committee. In relation to the committees' members, they advised to form them from a number of relevant agencies from both the private sector and the public sector.

In contrast, there were a relatively few environmental managers who completely rejected the suggested proposal of establishing a managing committee, they felt that instead there should be a research committee of experts established to address the problem of awareness in Saudi society. Also some managers felt that public awareness campaigns should be left to the Ministry of Education, to media outlets and mosques as it was deemed appropriate in a religious society that there should be an Islamic scholar involved in the promotion of public awareness.

The importance of potential behavioural changes with respect to environmentally-friendly water use.

Managers in the Ministry of Agriculture claimed in their data to be prepared to actively participate in the water of promotion conservation awareness, especially with regard to behavioural changes that would lead to an environmentally-friendly use of water. First, people would need to know which behaviours to avoid. The agricultural managers were prepared to use the experiences of international water organisations in order to plan such a campaign. Again, environmental managers are aware that public awareness needs to be harnessed to actions, which recalls research sub question seven.

The behaviour change that most concerns the agricultural managers is water irrigation, which includes domestic use in addition to industrial and agricultural uses. Their data suggests as a solution a campaign could be organised at government level and carried out by project managers who would instruct and encourage the use of new and efficient techniques of irrigation. To this end, printed media could be distributed to households and teaching programmes including field visits could be organised for farmers, in order that they could determine the actual quantities of water needed for each type of plant, to reduce waste water.

Environmental Managers in the Presidency of Meteorology and the Environment: Similar to the agricultural managers, the data from the PME showed that they were confident that they could contribute to campaigns to change behaviours, but that these campaigns would require careful planning and clear objectives. Some managers suggested working in partnership with the Ministry of Agriculture and the MOWE. They felt that they were already well resourced to promote awareness as they had a media centre that has already presented projects on water conservation and related environmental issues.

Suggestions of how to raise the community knowledge about water pollution issue.

The Ministry of Agriculture (MOA): generally these managers suggested working with three partnerships in order to improve pollution awareness. The first is an improved use of media, the second is through the school curriculum and the third, through developing the role of the family. With respect to media, the Ministry pointed out that there is a significant number of non-nationals working in Saudi Arabia, who speak a variety of languages and may not be able to access information in Arabic or English.

The Presidency of Meteorology and the Environment (PME): Their responses demonstrated that they believe that issues of water pollution are best dealt with through environmental awareness programmes. Like the MOA, the PME believe that the media must play a stronger role in promoting environmental awareness. The PME also suggested that the concept of patriotism could be used to stimulate public engagement, in that it should be seen as a patriotic act not to pollute the aquatic environment. Regulations may also be required to

prevent industry polluting water through contaminating the seas or wells. Individual actions such as these would need to be supported by national schemes to establish more water treatment plants to preserve the environment and reduce water wastage.

Suggestions on how raising public awareness of water issues could be most effectively achieved.

Engineers in the National Water Company (NWC): Taking an the overall picture of their responses, NWC engineers concluded that raising public awareness could be most effectively achieved through different forms of public education. Firstly, through the schools, via a curriculum that would be written to specifically address environmental and health issues. This would be especially important in primary schools. Secondly, awareness could be promoted through visual media, such as advertisements and bill boards. These images could be supported by documentaries on television or radio. Other engineers outlined the importance of partnerships with the mosques, in particular Friday prayers, and seminars could also be used to raise awareness. Promoting annual competitions in supermarkets or public places was another suggestion. Finally, a small number of engineers believed that only an increase in the price of the water tariff would effectively raise awareness about over consumption.

To raise public awareness, It should start from the early stages of education, and also by putting forward an integrated methodology of the public education to describe more clearly the water situation in the Kingdom and how every citizen can contribute in water management. (NWC)

Engineers' feelings about of the views of technical specialists in relation to IUWM, from the water policy makers in MOWE

The majority of engineers felt that the water policy makers in the Ministry of Water and Electricity did take into account views and suggestions related to IUWM, but only those in the top positions in the National Water Company. Furthermore, engineers judged that the level of consultation between the NWC and technical specialists is still at a weak level. In this regard, some engineers propose that it would be beneficial to have a committee of technical specialists and consultants for the submission of proposals linked to the Board of Directors of the National Water Company. The Minister of Water and Electricity should be the chairman. Finally, there

were some comments on the need to review some of the policies of the Ministry of Water and Electricity, in order to assess the level of their current success.

4.3.4 Lecturers and academics in the Saudi universities

Lecturers' understandings of the main water issues:

Responses from Lecturers and researchers in Saudi universities revealed that they perceive water as a major issue that will be critical for the future of the Kingdom of Saudi Arabia. The issues that concern them most are summarised in the list that follows. In the course of the discussion, it will be clear that academics agree with the engineers and environmentalists on many points, particularly a lack of co-ordination in management and insufficient raising of awareness. Their solutions also have similarities in that they also see a need for centralised planning both in the provision of water and in raising awareness, before adequate levels of participation and engagement can be achieved. They also describe increasing water awareness in terms of a culture of awareness. This is an effective all-encompassing term that expresses how the raising of awareness and increased participation needs to be embedded into public life in order to produce the positive actions referred to in the research sub questions. Their concerns are summarised below:

- **Problems related to the Environment:**
 - Lecturers believed that the main issue in the Kingdom is the Environmental dilemma of having no natural renewable resources for fresh water.

- **Problems related to institutions and to the public:**
 - The continuing increase in the demand for water and how to deal with it.
 - Rationalising the consumption and use of water and especially agricultural, and the issue of appropriate laws and regulations to address this.
 - The field of recycling and the under-use of used and treated water(gray water). Trees and green plants should be irrigated by re-used water, especially as they are not for consumption.
 - The privatisation of water projects.

- Issues related to developing advanced techniques in the field of irrigation.
- The excessive use of aquifers in agriculture.

The main problems are summarised below:

- 1- problems related to drinking water (problems of the severe shortage of drinking water supply in some regions – problems of the maintenance of desalination plants – how to educate people to save water - not providing all the cities and villages with the water supply networks.
- 2- Problems related to the management of irrigation (drilling wells without a license – the excessive use of groundwater/aquifers (depletion of aquifers) - not choosing the appropriate irrigation systems for some crops and trees
- 3- Problems related to recycling of gray water - contamination of groundwater/aquifers by some industrial factories- drainage and under use of an occasional sudden discharge of rain. (Saudi Lecturer and Researcher).

Some of the main water issues in KSA are as follows:

- a) Unavailability of fresh water resources
 - b) Expensive water treatment techniques
 - c) Inadequate waste water treatment and reuse
 - d) No extra drainage system to deal with storm water
 - e) Non-renewable groundwater aquifers and fossil aquifers.
 - f) Excessive water use for agriculture.
- (Saudi Lecturer and researcher's comment).

Lecturers' understanding of the extent of the practice of IUWM

Firstly, all the lecturers and researchers questioned affirmed that the application of IUWM was essential to enable the water sector managers and the decision-makers to make the best decisions about fundamental water issues in the Kingdom. Again, like the other groups, they see IUWM as essential, but again they consider that it is practiced at a low level. Due to the urgency of the issue, academics believe there is a need to activate the principle of the integrated management quickly, but to do so would require more institutional and public efforts. Moreover, some academics pointed out that having so many organisations responsible for the water sector made it impossible to plan co-ordinated strategies among themselves. The current situation therefore requires the development of one national water strategy that could be applied by all organisations within the water sector and acting in partnership with it. This overall strategy could be planned by a team of experts from within and outside the water sector. As IUWM is still at a low level, public participation was correspondingly low and insufficient attention is paid by water managers to public engagement.

IUWM is applied and practiced, but it is not enough to enable it to reach to the concept of water balance and security, and the concept of sustainability, in which the efficiency

of the use of water has also not yet reached the required degree. Also there are problems in the services of the water networks in general, for example, the problem of reducing the percentage of loss in distribution and supply networks to homes. (Saudi Lecturer and researcher)

In this quotation, a Saudi teacher and lecturer responded by reflecting on the current Saudi situation and included some facts from the literature in the answer.

IUWM in its broader sense is described as the practice of managing freshwater, wastewater, and storm water as components of a basin-wide management plan. Saudi Arabia is one of the driest regions with very low rainfall, less or no freshwater resources and the wastewater reuse is also practiced on a limited scale. Because of the above mentioned problems, a huge investment was made in seawater desalination, water distribution, sewage and wastewater treatment leading to a substantial increase in access to drinking water and sanitation over the past decades. Over the past 80 years, Saudi Arabia has spent nearly \$25 billion on building and operating desalination plants. It now has 30 desalination plants and more than 2,500 miles of pipeline to pump the water they produce around the Kingdom. Despite improvements the service quality remains poor as in two major cities of Saudi Arabia (Riyadh and Jeddah) water was available only once every 2.5 days and every 9 days respectively in 2011. According to a previous study of Elie Elhadj from the School of Oriental and African Studies back in 2004 “one half of Saudi householders still have no municipal water connections and two thirds are without sanitation connections”. Also, Saudi cities have no rainwater drainage systems to deal with the storm water. (Saudi lecturer and researcher’s comment).

Lecturers’ perceptions on the scope for more integrated urban water management in the KSA.

All the academics believed that there is scope for further applications of integrated urban water management in the Kingdom of Saudi Arabia. Among the suggestions made as to the best form that IUWM should take was that a single organisation or Ministry should be responsible for the planning, management, distribution, supply, treatment and re-use of water. It was suggested that this organisation could be named the Ministry of Water. In support, there could be a committee or higher water council in every region to work with other institutions and oversee the development of public participation and the distribution of tasks.

There should be interest/attention paid for the environmental awareness, and explanation the real dimensions of the water problems in the Kingdom in order to apply cycle of the integrated management at the households/individuals level, institutions level and companies level. (Saudi lecturer/researcher’s comment).

Yes, there is scope for more application of the IUWM, and the most important elements for the IUWM are: firstly achieving the balance between water demand and supply: - water supply depends on water sources both traditional and non-traditional – water demand is agricultural, industrial and residential; secondly forming a strategy

for water, including full water data and analysis also the demonstration of the data.(Saudi lecturer and researcher's comment).

Yes, there is scope for more application of the IUWM, by increasing the efficiency of local experts in the field of water and by increasing the community knowledge of water resources and how to rationalise and save water; and by the increase the of efficiency of water use and by correcting the water use, especially in agriculture.(Saudi lecturer and researcher's comment)

Yes, the scope for more IUWM is high in Kingdom of Saudi Arabia. Along with desalination, the use of treated wastewater could help to reduce the strain on the KSA economy. Currently, only 45 % of all wastewater produced is actually collected and an even smaller fraction is treated and reused. Comparing to desalination, wastewater treatment has proven a much cheaper process, treating wastewater requires about one third the cost of desalinating water. Secondly the areas with moderate or high rainfall can use rainwater harvesting techniques at household level to meet their daily needs. The freely available rainwater can also be used for drinking with little treatment.(Saudi lecturer and researcher's comment)

Perceptions of barriers and challenges that might face the implementation of IUWM

The following list of barriers and challenges was taken from the lecturers' and researchers' data:

- Multiplicity of the responsible water organisations in the water sector.
- Lack of proper and accurate data relating to water sources in general and in particular the information associated with aquifers.
- One of the most prominent obstacles is the ignorance about the importance of integrated urban water management, in addition to a autocratic decision making that does not prioritise IUWM.
- The challenges are in the development and management of water resources over a long period of time.
- No implementation of the recommendations and conclusions from academic research from the universities and the scientific institutions.
- Lack of knowledge and failure to understand the importance of re-using treated water. In particular there is a lack of participation from women.
- Lack of transparency and also lack of quality in the implementation of some water projects.

Solutions and recommendations to address the barriers and challenges:

1. Set and establish a single organisation for managing the water sector to carry out comprehensive planning and the integrated water management.
2. Create a database of accurate information related to water, to be updated constantly, using the newest information systems and technologies.
3. Research bodies must adopt a clear national water plan for integration in the management of water and submit the plan to policy makers in order to take necessary decisions and actions.
4. Raise awareness of water saving.
5. Train human resources in the water sector.
6. Follow the highest global standards of engineering quality specifications in the implementation of water projects, particularly the water networks.

At the level of the financial and the technical, there are no obstacles or challenges that may face the application of IUWM in the near future, but public opinion of the management and re-use of treated water represents the dilemma which needed to be addressed, and also the focus for the spread of a culture of the re-use of treated water between Saudis.(Saudi lecturer and researcher's comment)

In the water sector the barriers are: lack of coordination between water organisations that interfere with the responsible organisation of water services, for example, there is poor coordination between the municipalities and the Ministry of Water – not having adequate and accurate water information when needed - the lack of clear laws and legislation that urge people act. (Saudi lecturer and researcher's comment)

One of barriers in the implementation of the IUWM, which (an issue) is relevant to saving water; is how to convince consumers (citizens and foreign people) about the importance of water conservation and this conservation will benefit them; in which in the Kingdom there are many different nationalities that are difficult to convince them as well.(Saudi lecturer)

In my opinion, the most important barriers and challenges that face the implementation of IUWM in the Kingdom are: 1-not having a good application of recommendations from scientific research in universities and institutes 2- lack of spreading awareness among the people for the rationalisation of water consumption.(Saudi lecturer)

Desalination is the major technique for supplying water but it is very expensive because of high oil consumption. Although the KSA is rich in oil resources, the high consumption of this precious matter is not wise. Solar power is an alternate and

economical solution for desalination and the Saudi government plans to invest more than \$50 billion in new and upgraded desalination plants over the next 15 years. (Saudi lecturer)

Lecturers' perceptions of the level of public awareness, attitudes and behaviours in relation to water issues in KSA

Most of academics consider that although there is water awareness in the Kingdom at the governmental level, public awareness, attitudes and behaviours towards water issues are considered relatively limited by the academics, in fact there are a small number who believe that it is very weak. There is also a perception that public attitudes are related only to the individuals own interests, as there are citizens who waste water for their own self-interest or enjoyment. In the opinion of many researchers however, public attitudes and behaviours could be improved by linking the issue of water awareness to the Islamic religion because Allah will ask us for this blessing (water).

Others argued that a culture of concern could be instigated through public awareness campaigns and programs that could include information programs and lectures in schools and at universities. It was commented that the department in charge of promoting water awareness in the Ministry of Water and Electricity should be better coordinated and approved companies could be used for the supply of water saving devices. Finally, there was a comment about the importance of motivating and compensating farmers choosing not to cultivate the banned crops which waste too much water; and at the same time motivate them to grow other crops that are reasonable and suitable for the arid country in terms of irrigation.

Water Awareness is weak and good behaviours are at a low level, and it could be improved by three Ees -Education of public – Engineering of water - Enforcement to save water. (Saudi lecturer)

Unfortunately, there is insufficient awareness, and public attitudes and behaviours towards water issues in Saudi Arabia are not good, as there is the wastage of a large amount of water whether for personal use or at homes or in the public utilities and also industry and agriculture. This can be improved through seminars, conferences and television programs that are aimed at spreading a culture of rationalisation and conservation in the consumption of water. (Saudi lecturer)

For increasing public awareness, I have listed ideas on a priority basis: 1- Classroom education at School, college and university level; 2- The media (online, TV programs, newspapers); 3- The Government Sectors. (Saudi lecturer)

As the KSA is situated in an arid region having neither sufficient rain and water resources nor easily available good quality groundwater, most of the domestic and industrial needs are met through sea water desalination. In contrast to its availability, water is cheap for all users compared to other developed and developing countries. However other than a few practices employed by public sector organisations in public places like Masajid etc., the awareness among the masses is poor regarding water conservation. Water fittings are not installed on water conservation principles, especially in homes, which cause huge water wastage. This can be improved by giving lectures especially in sermons in Friday prayers and making it compulsory to install economical fittings in washrooms at public places and in homes.(Saudi lecturer)

Perceptions of the level of the apathy shown to water issues by the Saudi community

From the researchers and academics' answers, almost half of the sample confirmed that they perceived that there is a large segment of Saudi society apathetic to the water situation in the Kingdom. It was also felt that the public did not interact positively with water issues and on the whole, the Saudi community should be more aware through media channels. It was suggested that this could be achieved through presenting specialised programmes through the Saudi satellite channels in order to raise public awareness about the seriousness of the water problem. Also printed media could be distributed in public places, schools and universities.

Similar to their colleagues in general education, some researchers also believe that there is a need to increase the role of Imams in bringing water issues to the fore. Significantly the issue of legislation was foregrounded, as some lecturers claimed that water laws could persuade the Saudi Community to be more proactive with the real situation of water scarcity. Incentives could also be provided such as offering prizes for contributions to public forums and open discussions.

Some of lecturers also commented that there is a need to inform the entire population in the Kingdom about the seriousness of the situation. The scarcity of fresh water requires rationalisation of all kinds of water uses.

On the other hand, a very small number of researchers believed that the Saudi society is fully aware of the importance of the water issues, and of its scarcity in the Kingdom. They noted that

this was visible in the behaviours of some people in the expectation of rainfall, because they understood its importance with respect to the supply of fresh water.

Yes the Saudi community is a fairly apathetic to water issues, and in relation to changing the thinking/thought of the Saudi community, and making the community is more proactive to the real situation of water scarcity in KSA, the Saudi experts and scientists of sociology should be asked about it.(Saudi lecturer)

The Saudi community is less concerned with water shortage as compared to the interruptions in water resources. The awareness regarding the shortage and conservation can be launched from school level and other public places.(Saudi lecturer).

Lecturers' views on the need to increase public participation in decision making in water sector:

On the issue of public participation in decision-making in the water sector, the majority of the academics deemed that there is no need to increase it, although their participation in decision making had been an important part of some of the paradigms discussed in the literature review. Some indicated that the governmental decisions should be enough as long as they are applied firmly. One lecturer cited the government decision to end the cultivation of wheat which did not involve public participation, as it was felt that it was unnecessary once the decision was approved following scientific study.

Again, with respect to participation, there were some comments in support of utilising the expertise that may be found in the private sector. This could possibly form part of a decision making process.

I believe that there is no need to increase the public's participation in decision making in the water sector, because governmental decision sufficient as long as the decision is applied strictly and firmly, for example with respect to the decision of stopping the cultivation of wheat, no farmers' opinions were taken and this was a significant decision to prevent water wastage.(Saudi lecturer)

There is no need for such participation in the KSA. However, the public can be encouraged to practice water conservation principles or subsidies could be given to those who practise such activities. (Saudi lecturer)

Lecturers' views on the most effective public awareness campaigns

Most of the academics clearly believe that the most effective public awareness campaigns would centre around mosques and schools in particular, followed by water service providers and other governmental organisations. These results are consistent with the other participants. Mosques can be particularly effective because the message can be repeated on a regular basis. The results are illustrated in the Figure 32 below.

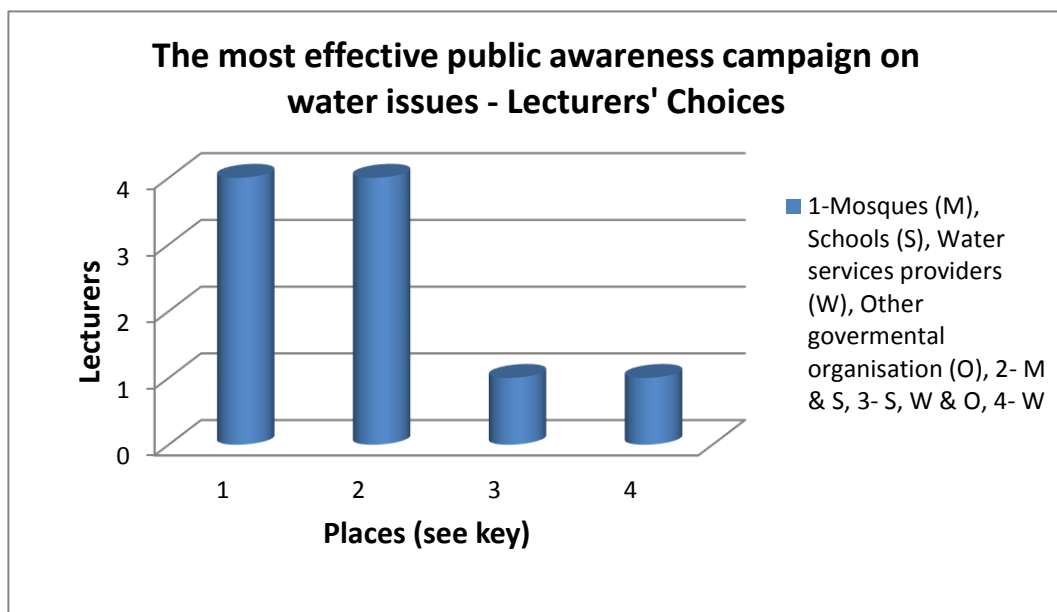


Figure 32: The most effective public awareness campaign on water issues - Lecturers' Choices

Lecturers' views and suggestions on how marketing tools could be adapted to promote eco-friendly water saving devices:

There was agreement about the ways in which commercial marketing tools could be adapted to social marketing in order to promote water saving devices. The data from the academic researchers produced the following suggestions:

Media and the advertising –through direct contact with consumers in major shopping malls – through visiting schools – through using technology, social media and free SMS.

However, although a proportion of academics see the value of media and advertising, the majority feel that direct contact will be the most effective. This can take the form of instructions,

advice through direct contact such as the home visits (farm visits could also be included) that could promote the free use of eco-friendly water saving devices.

The communication methods could be: 1- National projects on water planning 2- government and community collaboration for encouraging trade and specification of water entitlements 3- Selecting trial regions for demonstrating eco-friendly water saving devices 4- Integration of natural resource management and water supply planning. 5- Trade-offs, in order to examine a range of options and their implications. (Saudi lecturer)

The academics' data, as we have seen, is fairly consistent with that of the other participants. A significant difference is that they see raising awareness as being part of a whole culture of awareness, which suggest that they see this process as being integrated, in keeping with IUWM. It could be argued that this group have introduced the notion of a wider cultural change that must work alongside IUWM in order to raise awareness, encourage engagement and produce action, as outlined in the research sub-questions. The final set of data to be discussed is from the Saudi public, who have been named as the key to implementing successful IUWM through an essential awareness raising that should lead to positive behaviours around water conservation. It will be argued that this data will also indicate the need for a wider cultural change.

4.4 The public surveys

Public perceptions about the problems that face the KSA in terms of water issues:

Saudi Men: Through the thematic analysis of the questionnaires of forty five men from three regions (Riyadh, Jeddah and Albaha), the main problems are summarised below:

Some men see current water strategies as being purely short term and that there were no radical solutions proposed that could improve long term supplies of desalinated water or water for irrigation, or to encourage people to rationalise their water use. Others strongly believed that water security and the sustainability of resources are the most important problems because

dependence on desalination with its reliance on oil is unsustainable; and some suggested that nuclear energy should be considered as an alternative. Also there are problems with insufficient water currently stored by reservoirs.

In relation to water awareness and good practices and behaviours, the majority of the men believe that awareness and knowledge is at a low level among the citizens and consequently people do not realise the seriousness of the water situation in the Arabian Gulf; especially if there is war or in the case of the depletion of crude oil (because desalination is oil-based). In general, many men stated that there was a large amount of wastage by Saudi citizens and also from non-nationals, in addition to pollution of the seas and Wadi with sewage. The interviewees indicated the absence of a culture of responsibility towards pollution and were fully aware of the importance of water issues and conservation. It is significant that people are aware of water issues, which suggests that the kind of cultural change called for by the academics is also recognised by the public. It also suggests that the public is more concerned than the other stakeholders have realised.

I see that the problems of water in the Kingdom result from the following points: the scarcity of rainfall, the nonexistence of rivers or lakes, excessive water consumption whether in washing hallways in houses or in other uses, the mixing of sewage water with oil and food scraps in that most households dispose of used vegetable oils through the drains, the kingdom supports agriculture which depletes the aquifers and the lack of awareness of the importance of water and the dangerous future that the Kingdom will face. (man from Jeddah)

Men also expressed concern about the lack of renewable water resources and the non-existence of rivers in a desert country, in addition to the increased stress on aquifers around the Arabian Shield and the Wadi Al-Dawaser and Al-Qasseem regions, as a result of over use of water through irrigation; in particular the frequent use of pivot irrigation in the growing of crops and animal fodder.

Problems with the infrastructure of the water supply were discussed.

There is an issue of water security in general, and some the infrastructures are not good enough, which caused poor drainage of rainfall and even no drainage at all in some areas; and this is seen in several areas in the Kingdom. And for Riyadh City (the capital) I heard say that about 25% of the city of Riyadh is without rainwater drainage systems; and that more urban areas were planned, and people live in these

areas now; above the AssillieWadi/valley which extends to more than 100 kilometers from the south of Riyadh to the north. (man from Riyadh)

One such issue is the large percentage of un-purified, brackish groundwater in some villages, illustrating the inconsistency of the supply of desalinated water around all the cities and villages of the Kingdom.

Salinity of water, brackish water from artesian wells especially in the areas that are close to the sea, water pollution from the remnants of the black wells (septic wells), The lack of aquifers in some of the desert areas, the interruption of water for a certain period which means it has to be transported by water trucks, we hear it is because of the maintenance of desalination plants.(man from Jeddah)

Some also wrote about the difficulty of transporting water to villages in the high mountains in the southern region, where the roads are unsuitable to bring water by truck. In general, villagers from mountain and desert regions, particularly the furthest regions, all had problems with the frequency and the increasing price of truck deliveries. These two quotes highlight these problems of supply and infrastructure.

Unavailability or incompleteness of water services in every city or in every village or every hamlet is due to the lack of sewage and drainage networks or the absence of drinking water networks; and I can say that there is no integrated water services in any urban residential area in the Kingdom.'(man from Albaha)

There is bad drainage of rainwater, and large amounts of water is wasted and goes into deserts without being harvested; and there is no supply of desalinated water to many areas, villages and small towns are still dependent on water trucks which are filled from artesian wells or from desalinated water or purified water from some dams.(man from Riyadh)

Environmental issues are found to compound these problems with infrastructure. The lack of rainfall, even seasonal rains, in the central region of the kingdom (Najed the location of the capital city Riyadh), in addition to the inadequate harvesting of rainfall aggravate water shortages, as does the lack of seasonal rain in the South-western highlands; covering areas from Taif city to SaratAbeedah city.

With regard to sanitation and swage problems, it was stated that there is a failure in many areas to re-treat and reuse sewage water and in addition to this, poor maintenance of both sewage and drinking water networks. This leads to regular breaks in the water supply in some cities.

This data shows evidence that many members of the general public are aware not only of water issues (which are discussed in public), but also of the dangers that may be faced in the future. It does not support the views expressed by some water managers, lecturers and students, that members of the public are selfish about water use. It is significant however, that some of the quotations refer to interruptions to the water supply and describe the impact of relying on deliveries by water truck. There are regional differences implied which correspond to the availability of water and the infrastructure of supply. Also, it could be that a lack of personal responsibility may be implicit in the fact that water supply is in the hands of institutions, so the people seem not to feel that they have any involvement in the process. The next group to be discussed will be Saudi women, who have been described as a group that it is essential to target.

Saudi Women: The responses of the 45 females to the questionnaires can be summarised in the following topics:

There are many Saudi women who believe that there are not enough desalination plants to match current water needs and that water service projects are frequently delayed in new urban areas, in some cases leaving people without water services for up to two to three years.

I do not have the enough background knowledge to know about water problems in Saudi Arabia as a whole country, but I can speak about the water problem facing the Makkah region, especially in the Hajj and Umrah seasons, where the water supplies are interrupted and even cut off during those periods for some areas in Jeddah city; and I do not know if that is because of the lack of water sources or because of other reason. (Woman from Jeddah)

A large segment of respondents believe there should be more and improved desalination, in particular the reliable delivery of water is an essential solution, in order to avoid relying on aquifers and purified water from dams.

Incompletion of water services whether delivering water to homes or connecting homes to sewage networks, allowing citizens to live in unfinished urban area where water services are either not finished not provided with at all; and this leads to problems and a shortage of water transportation by trucks to those areas, Also I hear that the black wells (septic wells for sewage drainage) are harmful to the environment.(Woman from Riyadh)

There is also a belief that the water sector has been negligent in its own responsibility to raise awareness and promote rationalisation.

The problems are: non- availability of water, particularly south of Jeddah City, overpopulation and overcrowding of people in certain urban areas more than others, wasting water due to the bad drainage system, there is no promoting of awareness for the visitors and foreign residents about the importance of good and wise water consumption.(Woman from Jeddah)

This results in parents' lack of knowledge about responsible and appropriate behaviours, such as advising children in simple actions such as closing water taps. Additionally, some women are aware that they do not know what constitutes a reasonable amount of water for daily consumption. However, they are aware that water is overused, but believe that water companies do not do enough to raise awareness.

Saudi Arabia is facing the problem of a lack of the natural water resources, lack of rainfall which is leading to drought in wells and aquifers, nonexistence of lakes and rivers, and now water use increasing more than before, also increased by the presence of swimming pools and water sports, modern washing machines and irrigation for trees and indoor plants and washing the yard/courtyard/halls in the houses and cars. All of these things were not present before. (Woman from Riyadh)

Some women are concerned about the increased prices of water truck deliveries of desalinated water to areas that are not yet provided with a supply network. This is a high price in comparison with the cheap tariffs enjoyed by areas which are linked to the water network. Similarly, they feel that the water authorities do not communicate with these more remote areas and are not listening to peoples' concerns that they are suffering from water deprivation, especially in the region of Tehama (Tehama located near the cliff of the Sarwat Mountains in the South-western region of the Kingdom as shown in Figure 33 (map of Tahamah)).

Figure 33: Map of Tihamah

There is a low amount of desalinated water, and there is difficulty in transporting it to places far from cities, they neglect to raise awareness about responsibility of water use and they do not listen to the demands of people, especially people from far away areas. For example, in Albaha province there are incomplete sewage projects and incomplete water supply networks for desalinated water in all the cities and villages of Albaha Province. (Woman from Albaha)

In addition, there was some knowledge that water was not being reused in sufficient quantities in agriculture and industry and that the overall treatment and purification of used water is low compared with other developed countries and insufficient for overall needs in Saudi Arabia. In relation to the quality of bottled water, some women feel that these companies do not follow international standards for bottled water specifications. With regard to the pollution issues, many women think that there not enough signs warning against pollution of the coastal areas and Wedian (valleys). Moreover, building contractors were still using soft sand from the valleys without official permission, causing polluted lakes to form which also attracted mosquitos and were a danger to children.

Again, there is evidence of genuine concern about water issues from the public, which is something of a contradiction to the views of other stakeholders working in education or within academia who perceive a lack of interest or concern from citizens. However, it is significant that in particular, women feel that the water authorities have not done enough to raise awareness and that there is an inequality in supply, with larger cities seemingly favoured over more remote areas. This again proves that IUWM is essential, because infrastructures need to be improved

so that all stakeholders have reasonable access to water. The public cannot be expected to be fully engaged in water issues if they do not have fair access to supplies.

Saudi Public's reaction to public awareness campaigns

Saudi Men: The data shows that 42 out of 45 men did not make contact with any public awareness campaign relating to water through any media outlet. Out of the other three, one from Riyadh described 'a campaign by the National Water Company for detecting leakages inside the house in order to save the water', and he noted that the campaign has been fairly effective. The Second was also from Riyadh and he participated in a campaign with the Scouts which addressed appropriate water use and the use of new methods to rationalise consumption. He adjudged the campaign as excellent because was organised through the Scouting movement, who are managed through the directorates of general education, but only with boys' schools. The third respondent, from Jeddah, reported that he witnessed a 'campaign of rationalising water consumption by the Ministry of Water and Electricity', but believed that its effectiveness was at an intermediate level.

Saudi Women: Similar to the men, only two women had experience of awareness campaigns and both were from Jeddah. The first recalled that she had received leaflets advising people to a fix water saving device – a Water-saving micro-emitter - on the pine trees in houses. The second recalled a campaign from about four years ago in cooperation with the municipality of Al-Rabwah 1 district (a large area of Jeddah city), free water conservation devices were distributed to be installed in the kitchen or bathroom of homes. Both of women believed that neither campaign did enough to educate people to save water. Finally, there was no indication that any men or women had any contact with campaigns in the Albaha Province.

Public perceptions of the success level of campaigns.

Saudi men: There was a common view that water awareness campaigns have a strong potential for success in promoting positive behaviours. Some respondents suggested that this could be achieved through partnerships with schools, mosques, universities, governmental organisations, the private sector and the media.

Additionally, there were comments about the design and presentation of campaign materials, which should focus on clear explanations of the true extent of the current and future problems of excessive water use. Also, there were suggestions for linking the water conservation to patriotism, similar to one of the suggestions from the environmental engineers.

By promoting public awareness, we can improve it up to 80%, where there will be a lot of knowledge of and understanding of many of the issues that were hidden, especially in the rationalisation of water consumption.(Man from Riyadh)

The influence of campaigns will be in good because we are a society which adheres to Islamic and humanitarian principles, and therefore this society only need for reminding and a guidance.(Man from Riyadh)

I think through campaigns the awareness and attitudes towards water issues can be greatly enhanced if the campaigns are organised through mosques and schools, with useful advertisements, aimed at the right place and at the right time. (Man from Jeddah)

Surely through effective campaigns there will be will be a positive impact on myself and on everyone who has a sense of national duty and patriotism. (Man from Jeddah)

Due to the lack of awareness campaigns, they are not benefiting citizens, but, I am confident that if there were campaigns directed to consumers, there will be a big response from most citizens.(Man from the Albaha)

Saudi women: Most of the answers confirmed that women also felt that successful campaigns would dramatically improve awareness and attitudes, but they felt that influence from home and school would be more successful in promoting awareness than the public awareness campaigns themselves. These would operate as reminders only, because habits ingrained at home among children, brought up with the notion of saving water, would last a lifetime. Again, this is reminiscent of the Dublin strategy which targeted women as a key focus group because of their role in the family home.

Also some women criticised the how water organisations failed to exploit social networking tools to promote community participation in water issues. Similarly, there should be more of an effort made to enable communities to see that they are part of the solution as well as part of the problem, which is an important emphasis that can encourage engagement and positive action.

The women also agreed that awareness campaigns with a religious aspect would have a more positive reaction from the public.

I see that the my consciousness will be influenced to the good by the campaigns, due to my concern not to waste water, and my awareness of the importance of water. (Woman from Riyadh.)

No doubt raising awareness in society is important, and it has an effective and positive role, but I think that the impact of campaigns is 40% and the remaining 60% is coming from the influence of the family and the school. (Woman from Riyadh.)

I expect that the campaigns will be very useful, especially to raise women's awareness about the best practices for water consumption and also it (campaigns) will have an effective role in water conservation urging people to use water saving tools and instruments with faucets to reduce the consumption and waste of water.(Woman from Jeddah)

I feel that my awareness will increase through campaigns and this awareness of course will reflect on my behaviours. (Woman from Jeddah)

It is definite that the campaigns of awareness will resonate positively with any person, especially as our religion requires us to do many things related to water. (Woman from Albaha)

Again, the public show concerns about water issues, are aware that they need to learn from awareness campaigns, but that the campaigns so far are too few in number to be effective and should work in partnership with mosques and schools.

Non-national Arab peoples' perceptions about the problems that face KSA in terms of water issues

The non-Saudi Arab residents are the largest segment of non-nationals in the KSA. Their responses are summarised as follows:

Men: Most of men in this group are aware that Saudi Arabia is an arid dry country and that water resources are very limited, leading to a reliance on desalination. On the subject of water resources, there were some concerns about the aquifers being non-renewable resources, as well as their quality of water, which does not always have good specifications, in fact there are negative perceptions about the effect of underground water on hair and skin. Moreover, many

men believe that in the areas that depend on aquifers, the only drinkable water is from bottled water in the supermarkets.

Compounding this, Arab men also believe that there is massive overuse of water due to a lack of awareness; but that the media does not play a role in promoting awareness. Finally, a small number of men commented that the water sector depends on a foreign and largely unskilled labour force, which is not a problem in itself, but that many workers may not have the correct qualifications or training to work on water projects. For example, they may overuse water.

Women: Similarly, they expressed doubts about the quality of tap water. Some non-Saudi Arab women from Albaha stated wrongly that the tap water is saline and undrinkable, and that it is harmful to hair. They believe that the government should provide Albaha and other small cities such as Abha with designated water like Jeddah and Riyadh, so that they do not have to rely on aquifers. Women from Jeddah and Riyadh felt the drainage system to be inadequate and they had witnessed rainfall being wasted as it was left to collect on the streets. The women felt there was a need for an effective system to gather rain water.

Non-national Arab peoples' reactions to public awareness campaigns relating to water in the KSA

Only one man, working in Riyadh, had taken and read a leaflet about water awareness to rationalise the use of water. He was aware that the leaflet had been distributed through students from King Saud University in Riyadh in a large shopping Mall. According to the women in the survey, they had seen nothing about water awareness and they had no contact with any campaign even as far as there being no instructional signs about water visible in the streets.

Non-national Arab peoples' perceptions of the success of campaigns for raising awareness of water issues.

In general, this group were positive that the public awareness campaigns will contribute to raising awareness, good attitudes and improved behaviours among Saudi and non-Saudi citizens alike, especially with reference to water conservation. In addition, some men felt that

university students were ideally placed to play a role in organising campaigns and should be given the opportunity to do so. On the whole, a need for improvement in campaigns of raising awareness is the most common theme in this group of respondents.

4.5 Summary of the quantitative data

The level of perception of public knowledge in terms of water issues in KSA:

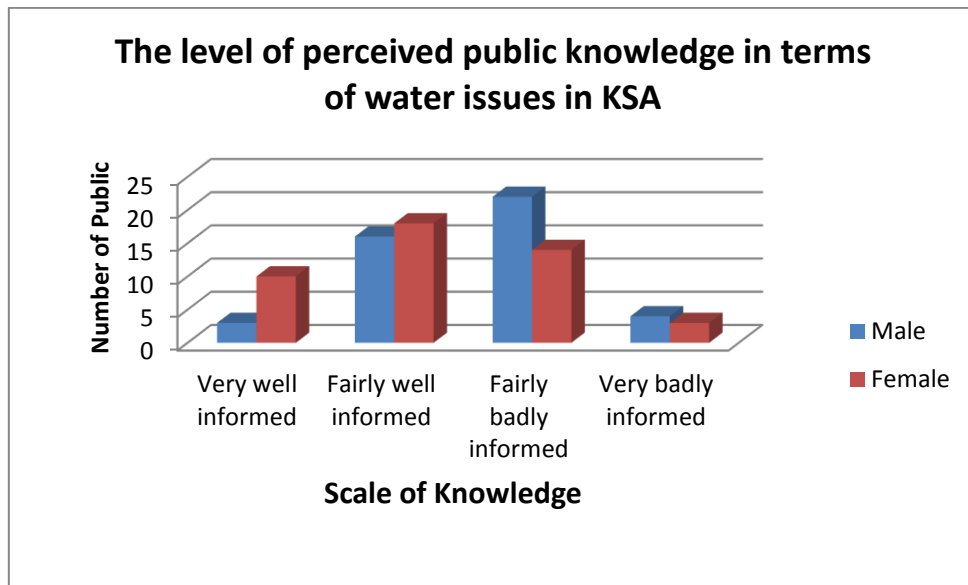


Figure 34: The level of perception of public knowledge in terms of water issues in KSA

The graph (figure 34) illustrates the level of perceived public knowledge in terms of water issues in the KSA in which nearly the half of the public sample consider themselves to be badly informed in terms of water issues in the KSA. Saudi males consider themselves to be more badly informed than the Saudi females.

Public perception of the average total daily domestic consumption of water per person:

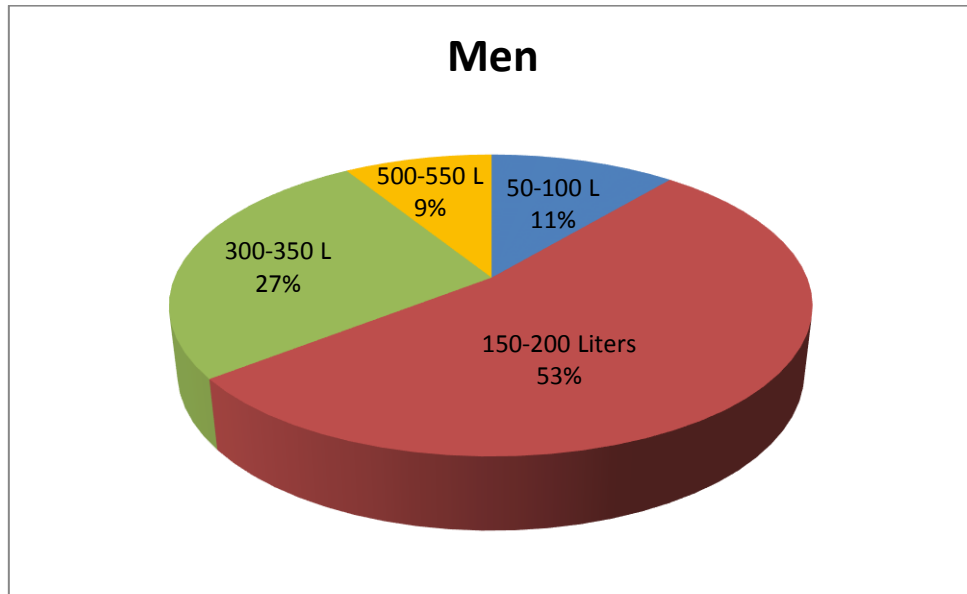


Figure 35: Public – males' - perception of the average total daily domestic consumption of water per person

Figure 35 demonstrates that more than of the men's sample (53%) believe the average total daily domestic consumption of water per person in the KSA is 150-200 litres, while only 27% of the Saudi males think it to be 300-350 litres, which is the actual average total domestic consumption.

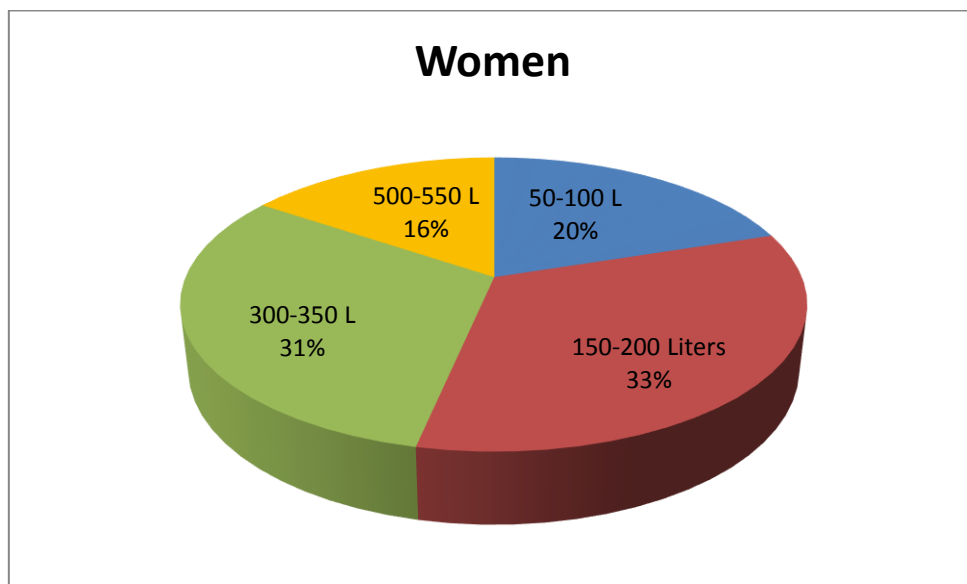


Figure 36: Women's perception of the average total daily domestic consumption of water per person

Figure 36 demonstrates that 33% of Saudi women in the sample believe the average total daily domestic consumption of water per person in the KSA is 150-200 litres, while only 31% of the Saudi females think it is 300-350 litres, which is the actual average total domestic consumption.

Public expectations of the percentage of the real cost of water provision to consumers

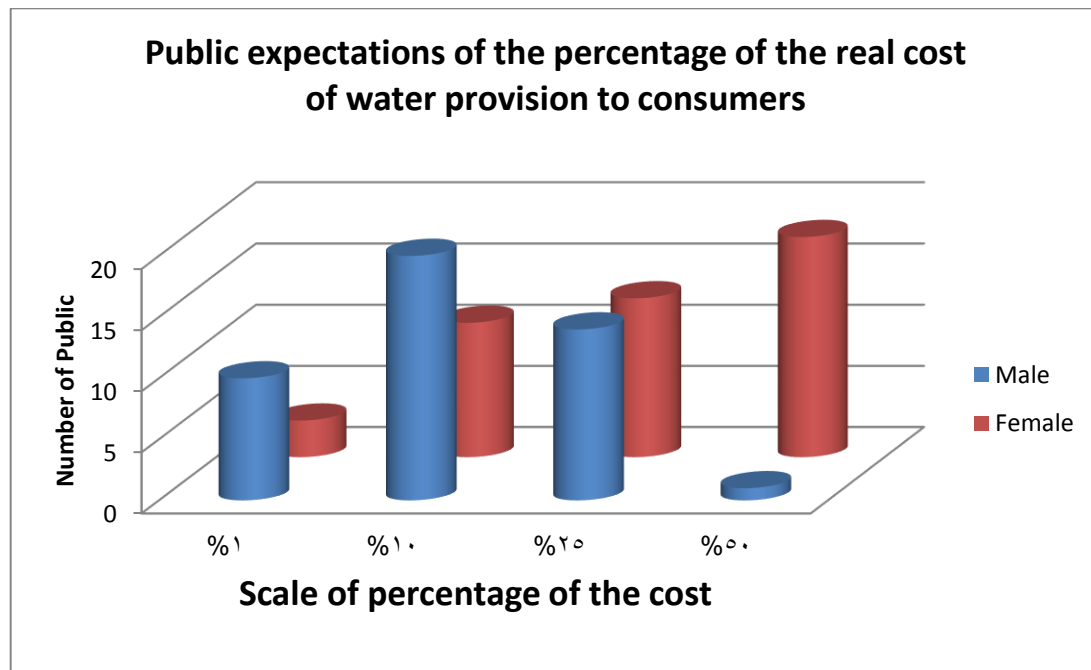


Figure 37: Public expectations of the percentage of the real cost of providing water to consumers

This graph (figure 37) shows that only few Saudi men and women believe that the percentage of the real cost to the consumers of water provision is 1% of the actual cost, with the government paying for the rest. Many people they think they are paying 25% of the actual cost. As a result, the public have some knowledge that the government pays a large percentage of the real cost but the public do not know that the government actually pays 99% in total.

Public views on the most efficient methods to save water

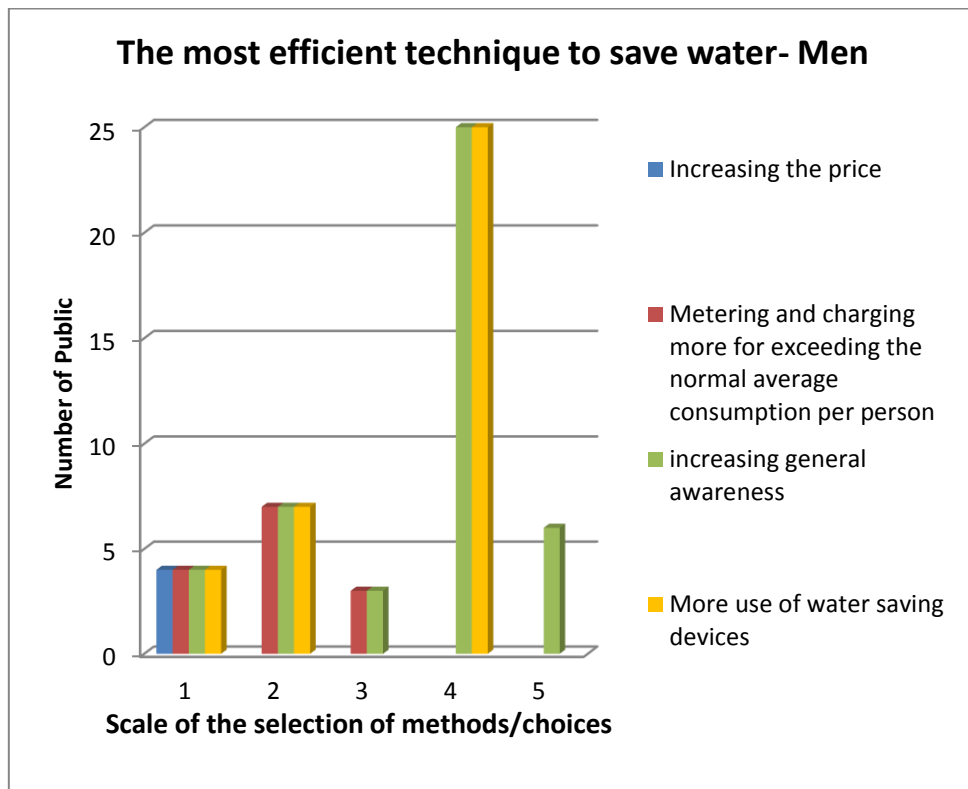


Figure 38: Public views on the most efficient methods to save water –males

Figure 38 has shown that most men believe that a combination of water saving devices and raised awareness will make the biggest difference to saving water. The scale shows the different combinations of the four methods and how they varied in popularity.

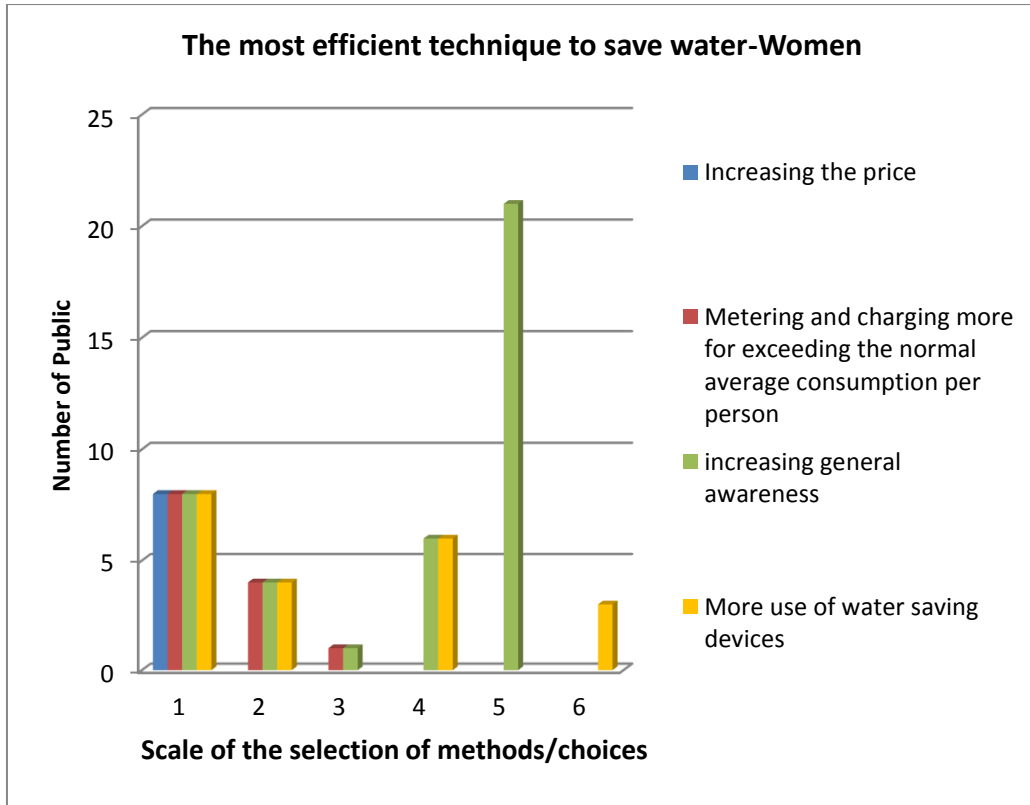


Figure 39: Public views on the most efficient methods to save water - females

The figure 39 has shown increasing the general awareness is by far the most efficient means of saving water, according to most women.

Public views on the most effective public awareness campaign about water issues

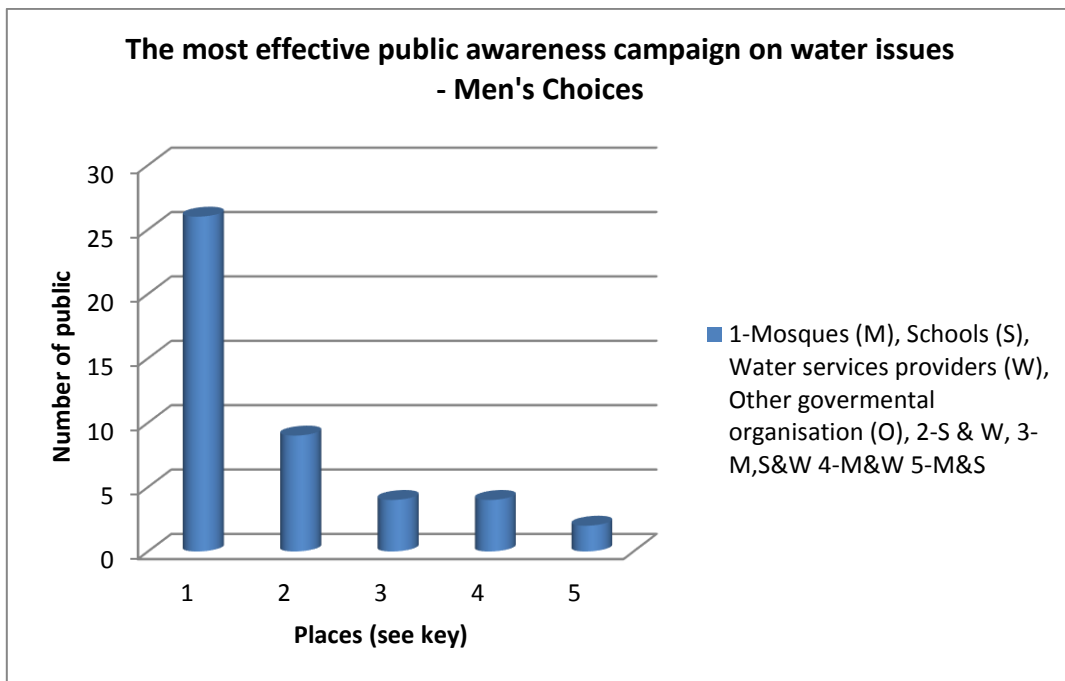


Figure 40: The most effective public awareness campaign on water issues - Men's Choices

Figure 40 shows that most men believe that the most successful campaigns will come mainly from mosques.

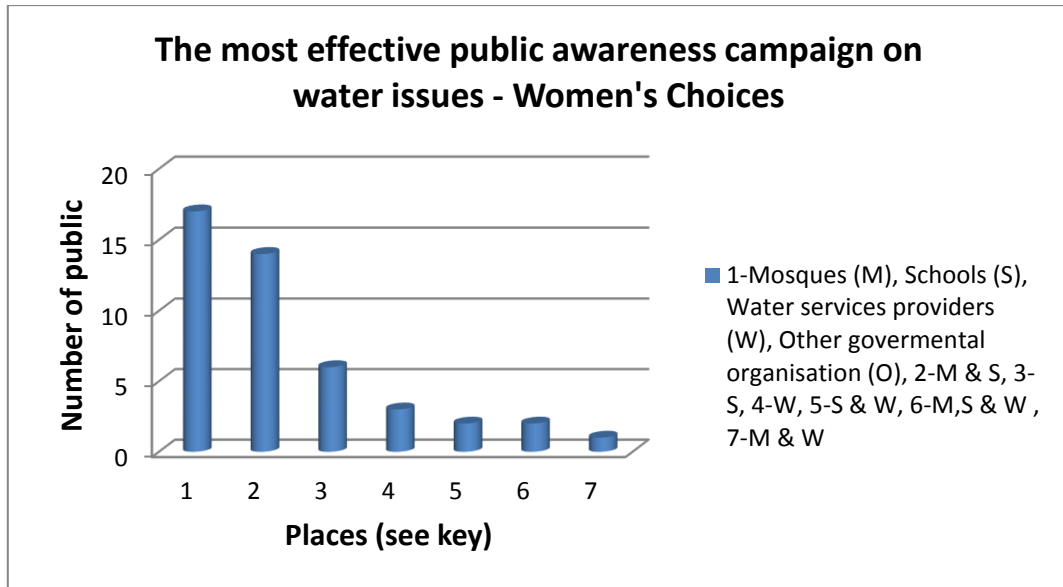


Figure 41: The most effective public awareness campaign on water issues - Women's Choices

From figure 41 above it can be seen that overall Saudi women think that the most effective public awareness campaigns would come from mosques and schools, with a considerably smaller percentage for other organisations.

Public reactions to water saving techniques

Table 11: Public reactions to water saving techniques

Group A of Techniques	I would never use		I already use it		I would use if it was provided free	
	Male	Female	Male	Female	Male	Female
Faucet/tap aerator (in kitchen or in bathroom)	11	18	6	8	28	19
Energy efficient Showerheads/ Water efficient dishwasher	22	27	3	1	20	17
Flush Less water saving displacement bag	17	36	5	0	23	9
Leak detector dye tablets	31	34	2	0	12	11
Group B of Techniques	I would never use		I already use it		I will use and recommend it to other people	
Low flush toilet	22	31	3	0	20	14
Water Saving Dishwasher	19	7	2	12	42	26
Water Efficient Washing Machine (Horizontal-Axis Washing Machine)	6	2	14	22	25	21
Grey Water Recycling (Recycling water used for washing to flush toilets) (at homes)	39	34	2	5	4	6
Rain Water Harvesting	42	45	0	0	3	0

Group A of water saving devices:

Public Reactions to using the faucet aerator:

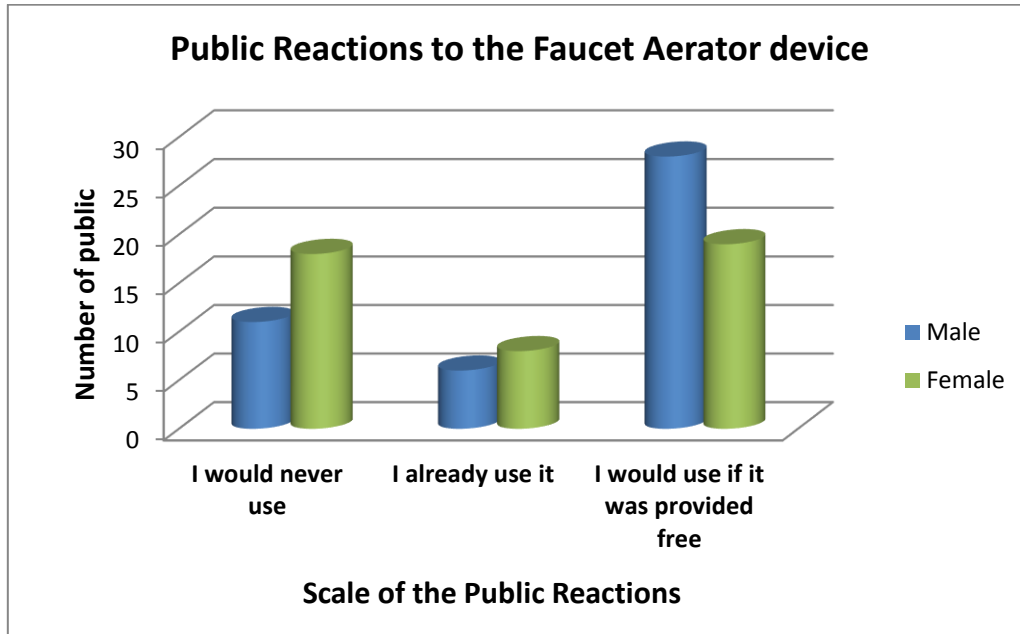


Figure 42: Public Reactions to the Faucet Aerator

Figure 42 shows that although only a few people in the sample had used this device, they would be prepared to use it if it were free, though in the case of women, it presents only a slight increase.

Public reactions to using the Energy Efficient Showerheads and the Water Efficient Dishwater

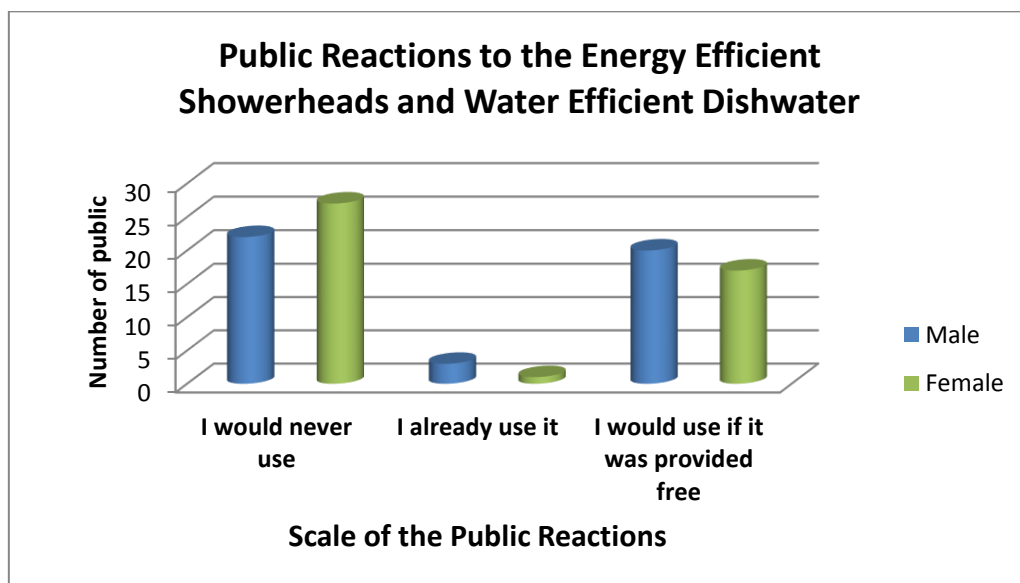


Figure 43: Public Reactions to the Energy Efficient Showerheads and Water Efficient Dishwater

Figure 43 shows that Saudi citizens were reluctant to use this device. This was particularly strong in the women’s sample, some of whom explained that they did not want to compromise their enjoyment in bathing or showering.

Public Reactions to using the Flush Less Water Saving Displacement Bag

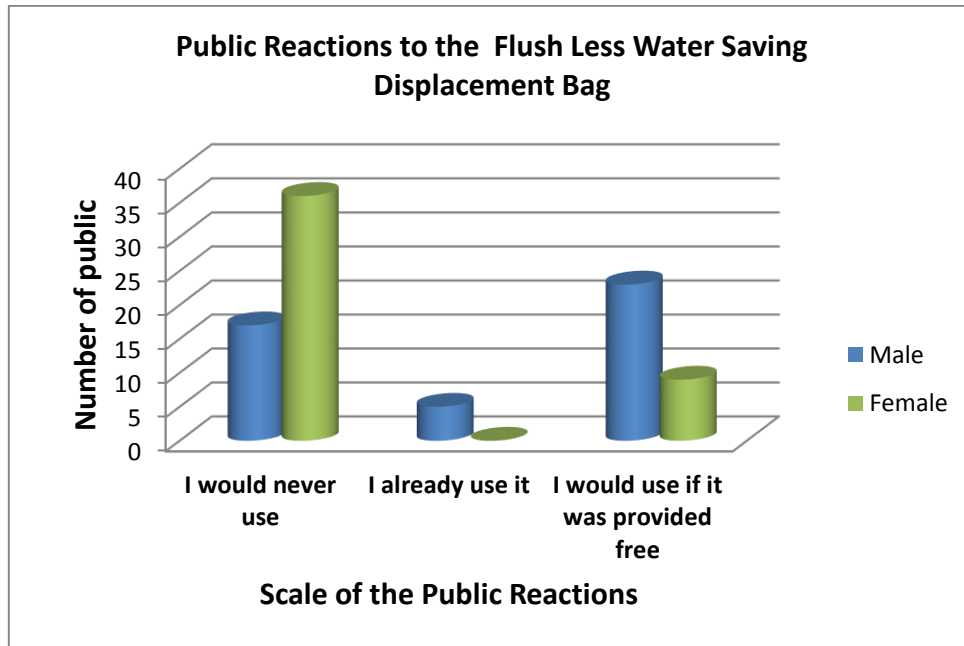


Figure 44: Public Reactions to the Flush Less Water Saving Displacement Bag

Figure 44 demonstrated that most of people have never used the Flush Less Water Saving Displacement Bag, particularly women, the majority of whom, unlike the men, would be reluctant to use it even if it were provided free. The main reason for the unpopularity of the device is because the majority of people are unaware of how much water is required to effectively flush the toilet.

Public Reactions to using the Leak Detector Dye Tablets

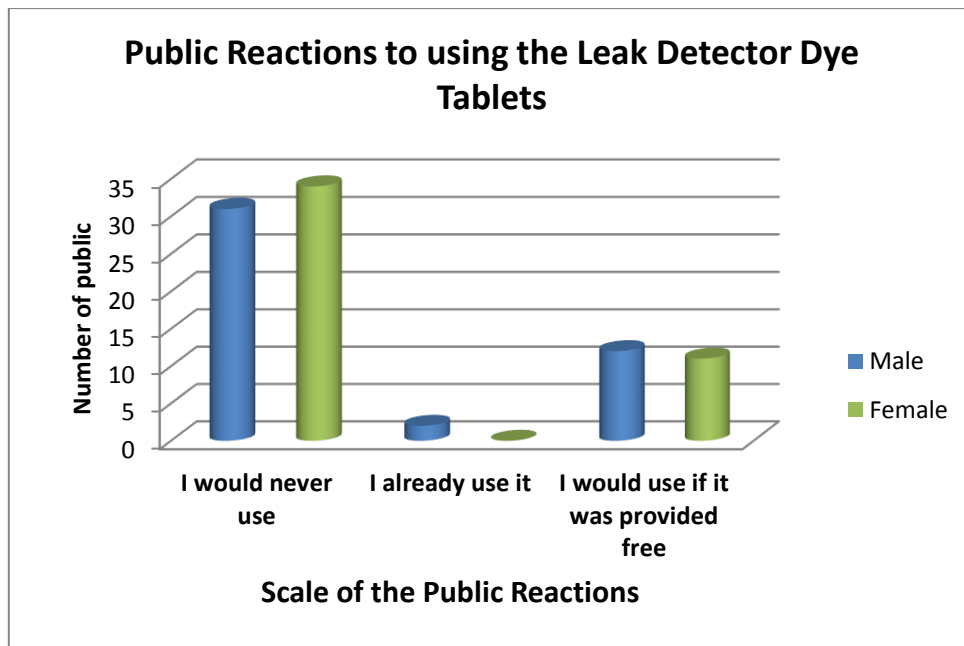


Figure 45: Public Reactions to the Leak Detector Dye Tablets

Figure 45 above illustrated that the majority of Saudi citizens would not use the leak detector tablets because they are thought to be unnecessary. This was in part due to a perception of the high quality of plumbing particularly in the new buildings, where the plumbers guarantee there will be no leaks. Also, some do not fully understand what a leak looks like and feel that they would be able to see it without the aid of leak detector tablets.

Group B of water saving devices:

Public Reactions/Tendencies with the technique of using the Low Flush Toilet

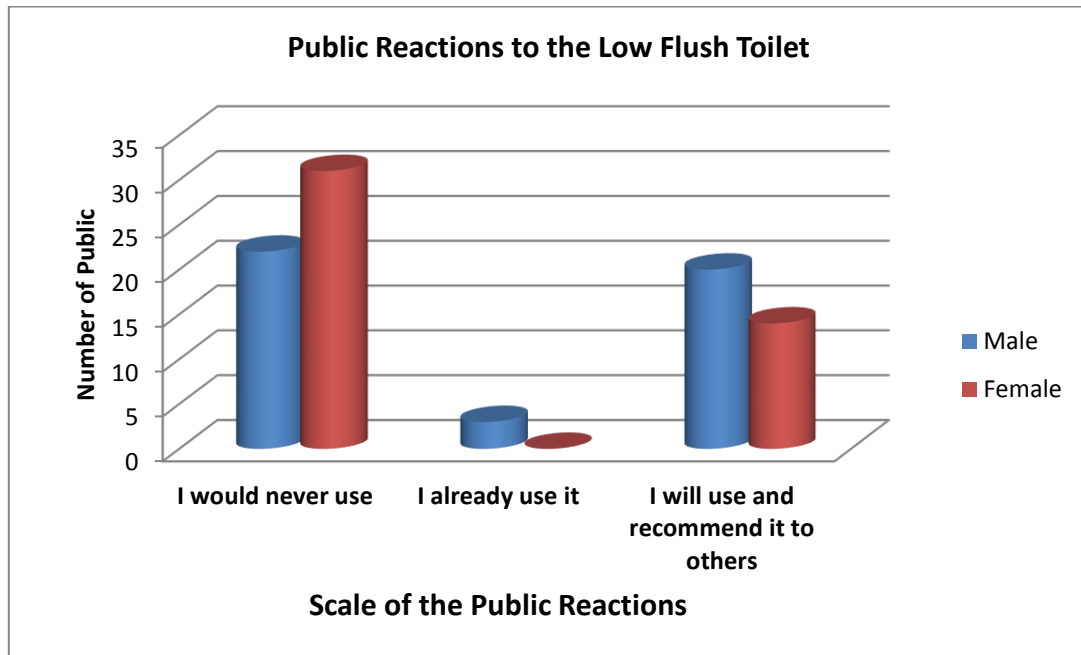


Figure 46: Public Reactions to the Low Flush Toilet

In the figure 46 we can see that public reactions to the Low Flush Toilet are largely negative in that more than the half of the sample would not use it, however, more than the third of the remainder of the sample were actually prepared to both use and recommend the device. This could be indicative of differing levels of awareness within the group.

Public Reactions to the Water Saving Dishwasher:

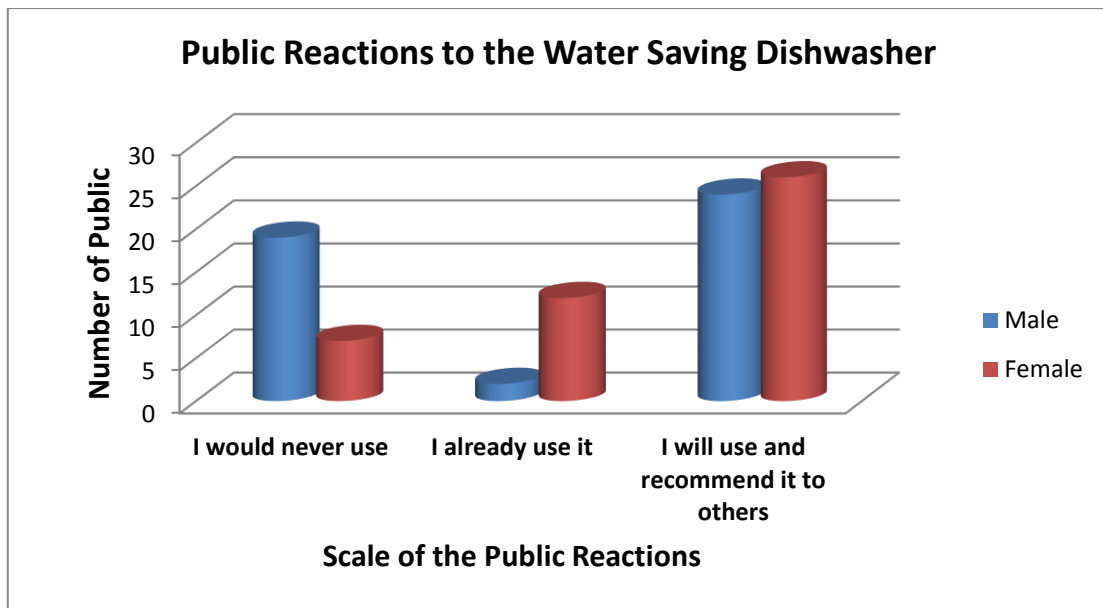


Figure 47: Public Reactions to the Water Saving Dishwasher

Figure 47 shows the a positive reaction from more than the half of the sample who are willing to use the Water Saving Dishwasher and recommend it to others; but in the meantime, there are about the third who would never use it particularly among the Saudi males, which as in the previous figure, could be indicative of differing levels of awareness in the sample.

Public Reactions to using the Water Efficient Washing Machine:

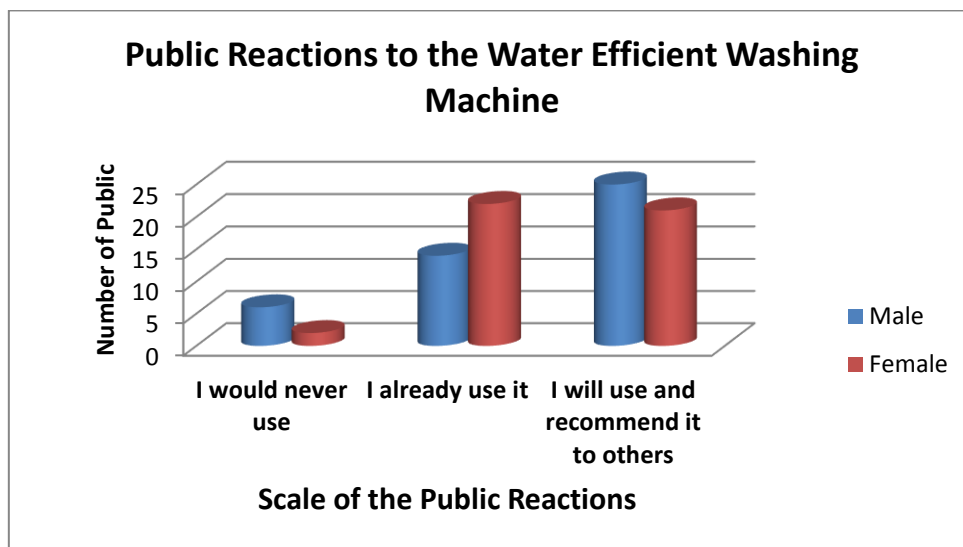


Figure 48: Public Reactions to the Water Efficient Washing Machine (Horizontal-Axis)

Figure 48 illustrates a very positive reaction to the Water Efficient Washing Machine (Horizontal-Axis Washing Machine), where more than third of women have already used it and more half

of the sample are prepared to try it. It is interesting that the concept of saving water in washing clothes seems more acceptable overall than in bathing or flushing the toilet. Again, this could be indicative of differing levels of awareness, in that explanations of the technology of water saving washing machines may be more available to the public.

Public reactions/tendencies with the technique of using the Grey Water Recycling:

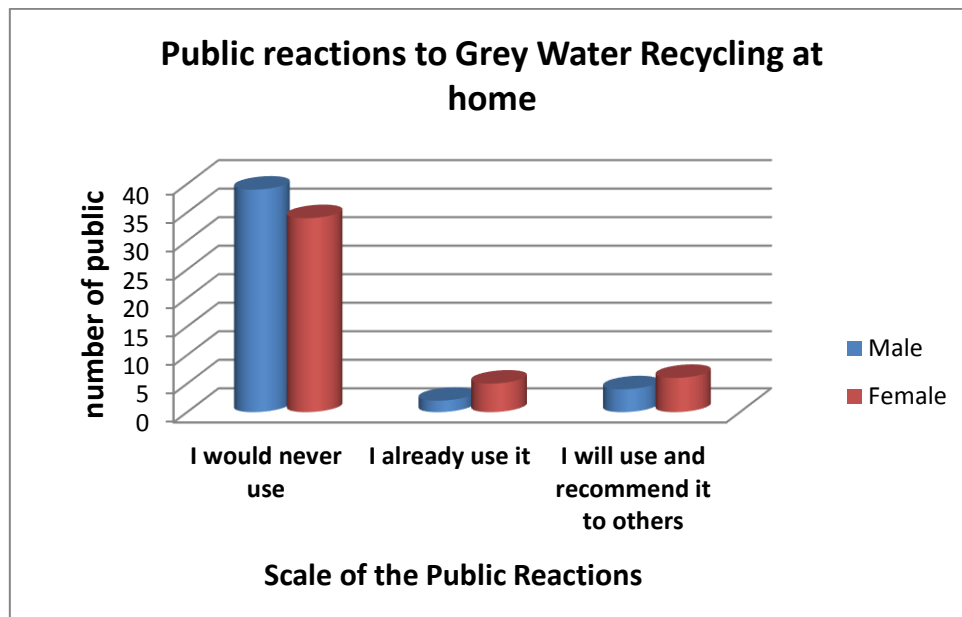


Figure 49: Public reactions to Grey Water Recycling

In this graph we can see that public reactions to the idea of using grey water recycling to flush toilets at homes are strongly negative where the majority of Saudi people have shown that they would never consider using grey water recycling at homes. There were, however a few exceptions among citizens who would sometimes use the grey water to flush and clean following the use of the vertical-Axis Washing Machine. Again, here is an opportunity to target awareness, as these negative reactions could suggest a general lack of knowledge, hence suspicion, about this technique.

Public reactions to using the Rain Water Harvesting:

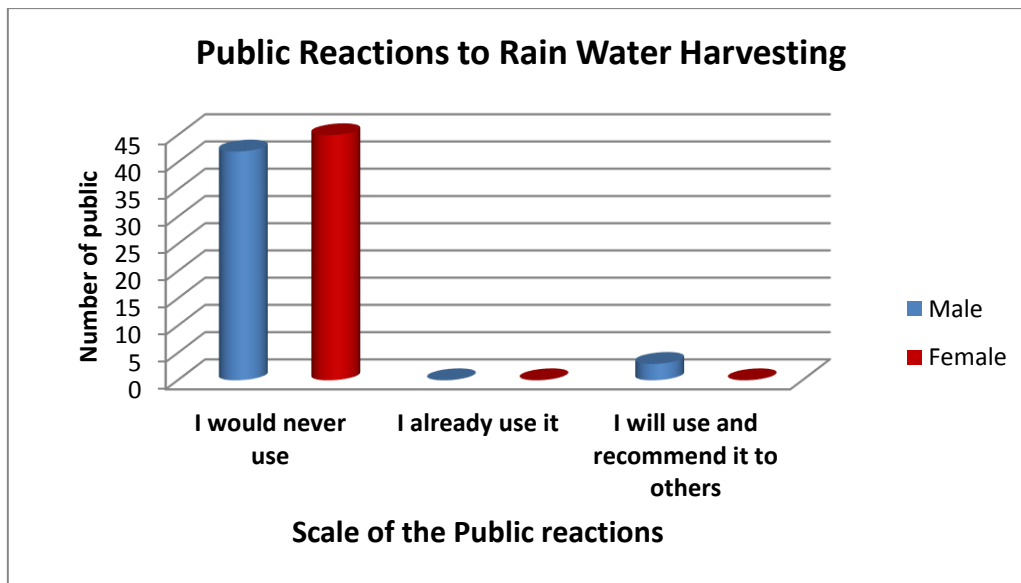


Figure 50: Public Reactions to Rain Water Harvesting

The diagram shows the almost entirely negative view to the idea of collecting or harvesting the rain water. Only three males from Albaha city would use rain water harvesting. The city is in the south-western region of Saudi Arabia which has seasonal rainfalls in the summertime. This could make the idea of collecting water seem more worthwhile, as residents in the drier areas stated that the rainfall is so limited that it is not worth the effort to harvest it, even for watering gardens and trees. This agreement also extended to economic factors, as people explained that the cost of installing the necessary equipment was too high in proportion to the low amount of rainfall the KSA.

In addition, a few members of the public preferred to let rainwater go into the drainage systems if available, where it would then be the responsibility of the water authorities, or in areas where there are inadequate drainage systems, people were happy to leave it to dry out.

This indicates a collective lack of responsibility around rain water from the general public. This could be cultural in part, because reference was made to the harvesting of rainwater before the 1940's. Saudi people had used to collect rain by digging in the rocks in the mountains make small reservoirs for saving water. The Arab people (Saudi, Emarati, Kuwaiti, Omani, Qatari and

Yemeni people) in the Arabian peninsula used to regularly harvest water until about 1945-1955, when crude oil was discovered and new conceptions of society, modernity and technology became current. It could be that Saudi people now see the harvesting of rain water as something that no longer has a part in their everyday lives.

Summary and comparison of public reactions to water saving devices:

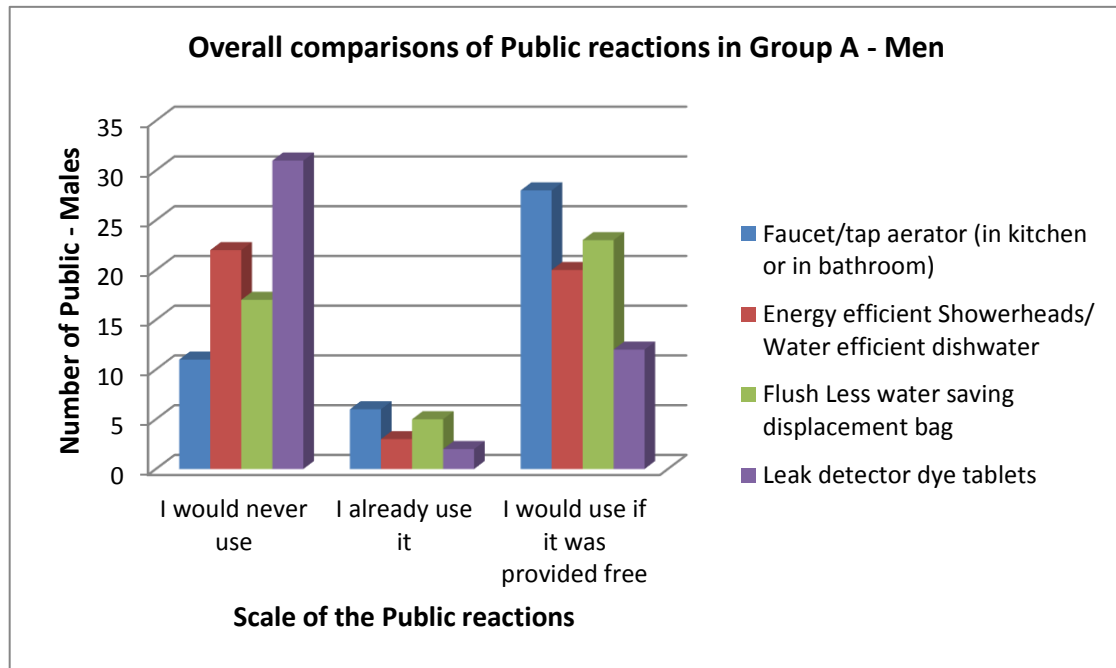


Figure 51: Comparisons of Public reactions for men in group A

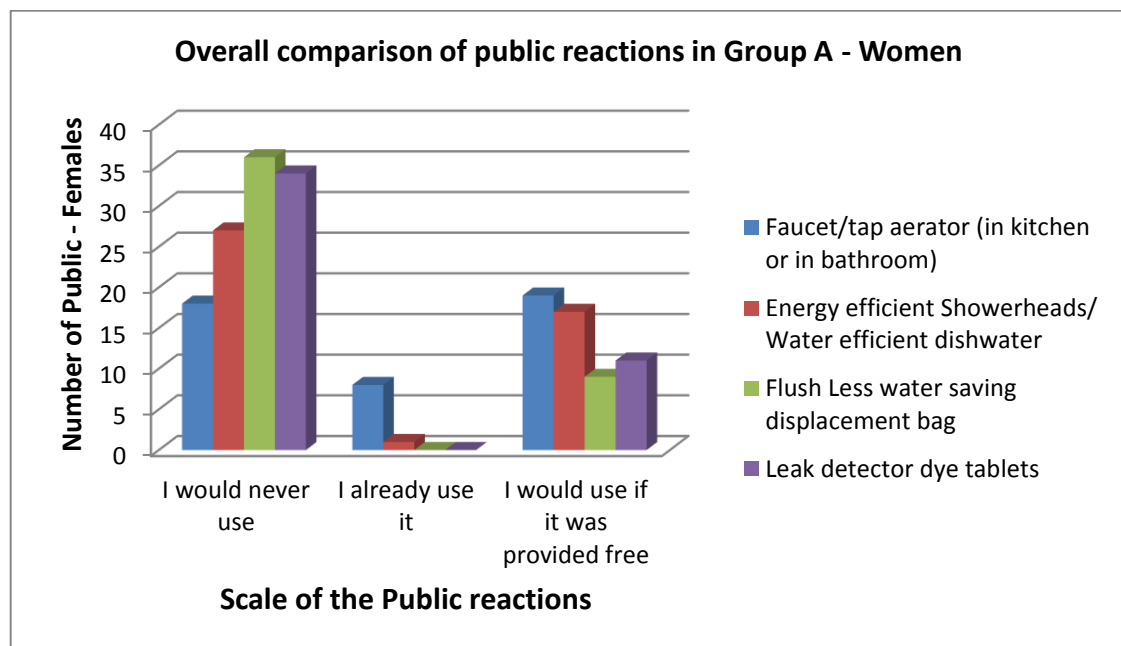


Figure 52: Comparisons of public reactions for women in Group A

In group A, the tap aerator in kitchens or in bathrooms had the best reaction from both men and women, but also it is clear from both graphs (figures 51 and 52) that women had more negative reactions than men with respect to all the water saving devices. This is a contradiction that needs to be addressed by water saving campaigns, in that although we saw in the previous set of data that women are interested in water issues and want to be better informed, on the whole they do not seem so prepared to take responsibility with respect to their own household usage. This could be addressed by a targeted campaign to educate women as to the true amount of water that is needed for household cleaning tasks.

With the water saving devices presented in group B, there were positive reactions to the idea of using the Water Efficient Washing Machine (Horizontal-Axis Washing Machine) and the water saving dishwasher for both men and women. Grey water recycling and rain water harvesting met with an almost completely negative reaction, partly for the reasons discussed above: there is a lack of knowledge about how efficiently grey water can be used in some household tasks and probably also a perception that it is 'dirty' water, in addition to a sense that water harvesting is something that no longer applies to people's everyday lives.

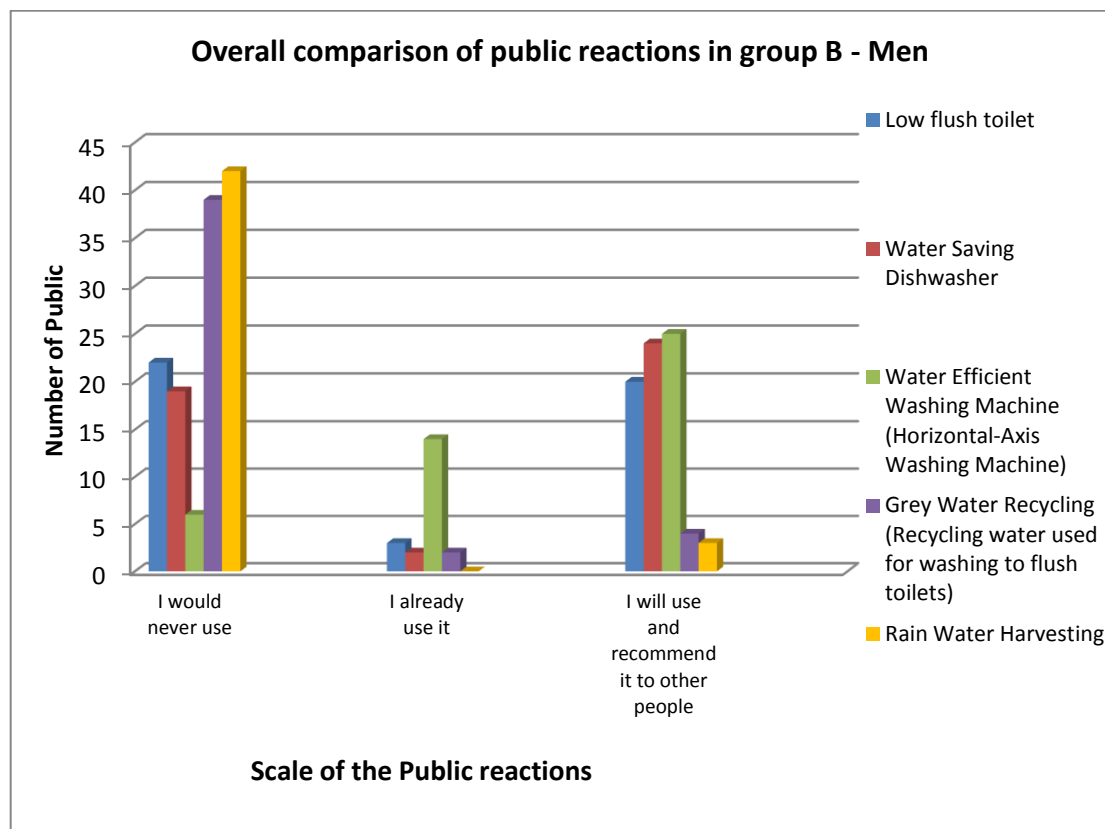


Figure 53: Comparisons of public reactions for men in Group B

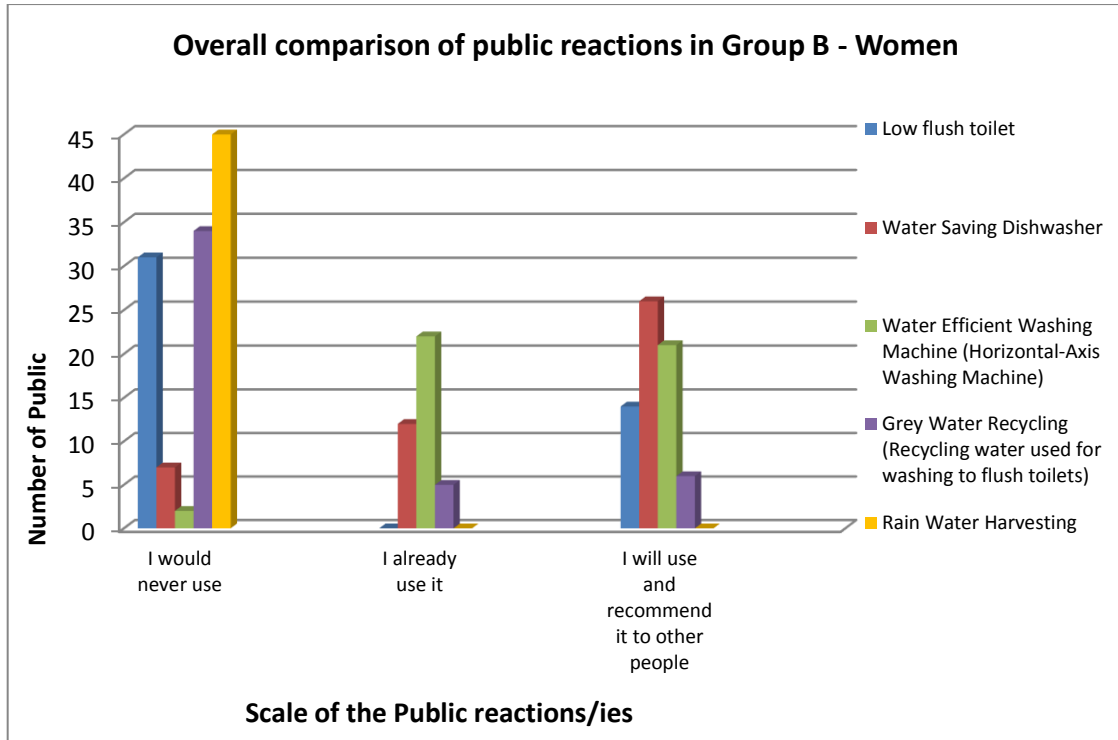


Figure 54: Comparisons of public reactions for women in Group B

Non-national Arab people in the Kingdom of Saudi Arabia

The level of knowledge from non-national residents in terms of water issues in KSA:

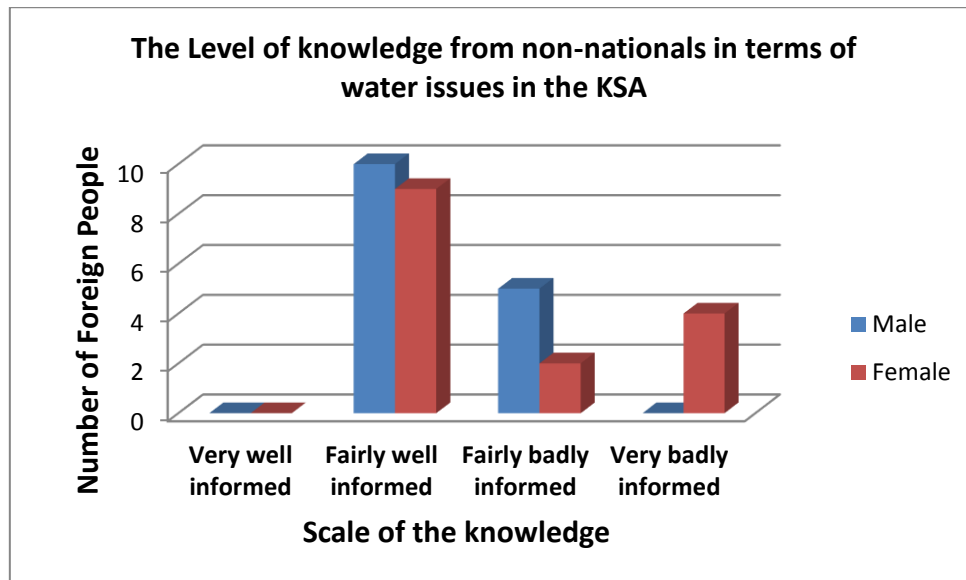


Figure 55: The Level of knowledge from non-nationals in terms of water issues in the KSA

The majority of those sampled consider themselves to be fairly well informed in terms of water issues in KSA, but also there are some who feel they are badly informed. The high percentage

of positive responses could well be due to similar geographical conditions that influence water resources in other countries in the Arabian peninsula.

Non-nationals Arab peoples' views on the average total daily domestic consumption of water per person:

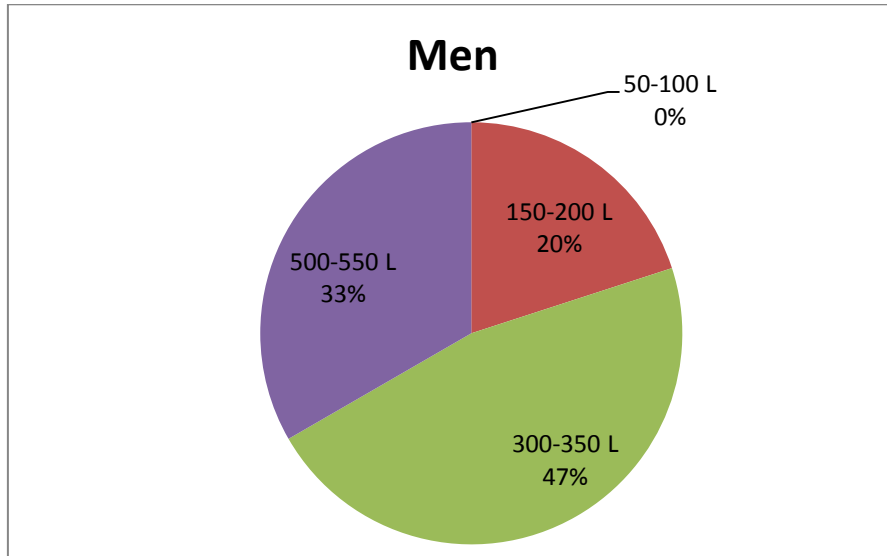


Figure 56: Non-national male views on the average total daily domestic consumption of water per person

Figure 56 displayed that approximately half of the sample (47%) are aware of the correct figure, but that the rest significantly either over estimate or under estimate the average daily domestic consumption.

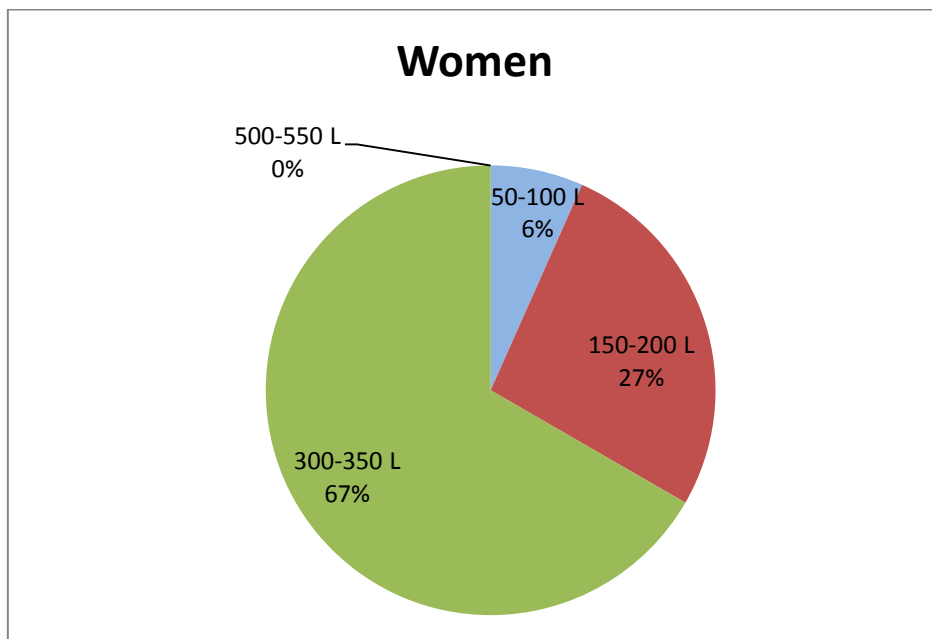


Figure 57: Non-national female views on the average total daily domestic consumption of water per person

Here, Figure 57 shows that almost two thirds of the women questioned knew the correct figure for daily usage, which indicates a higher level of awareness.

Non – national Arab peoples' perception of the real cost paid by consumers for water provision.

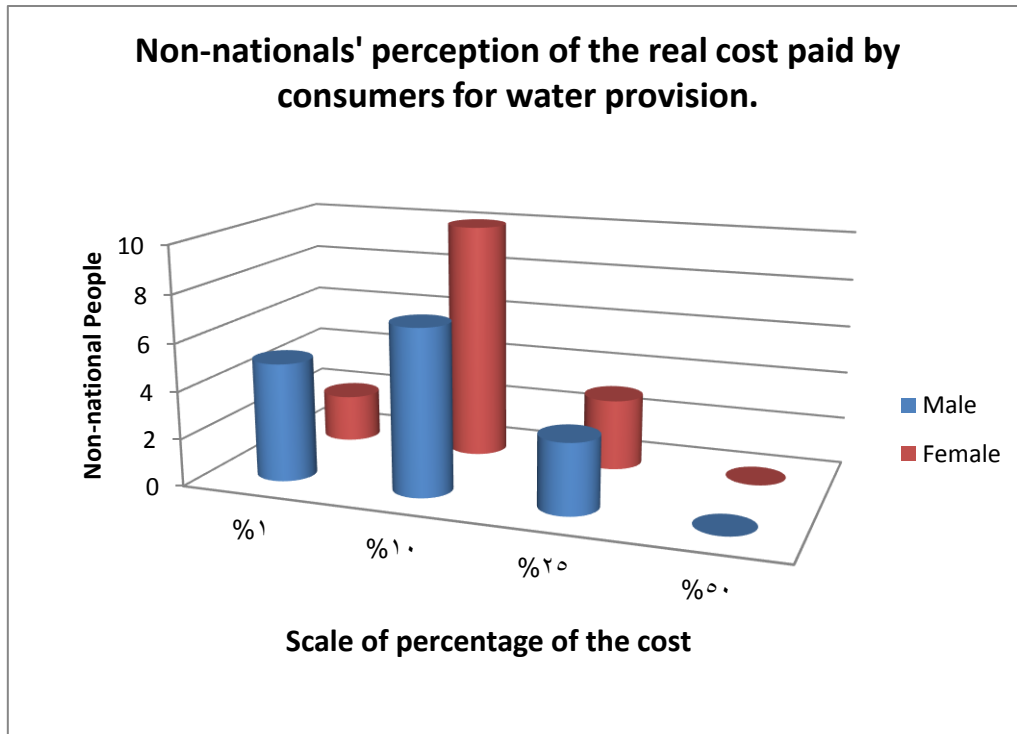


Figure 58: Non-nationals' perception of the real cost paid by the consumer for water provision

Figure 58 shows that a relatively small number of people understand that the public pays only 1%, while the government meets the other 99%. The most common perception was 10%.

Non-national Arab peoples' views on the most efficient methods to save water

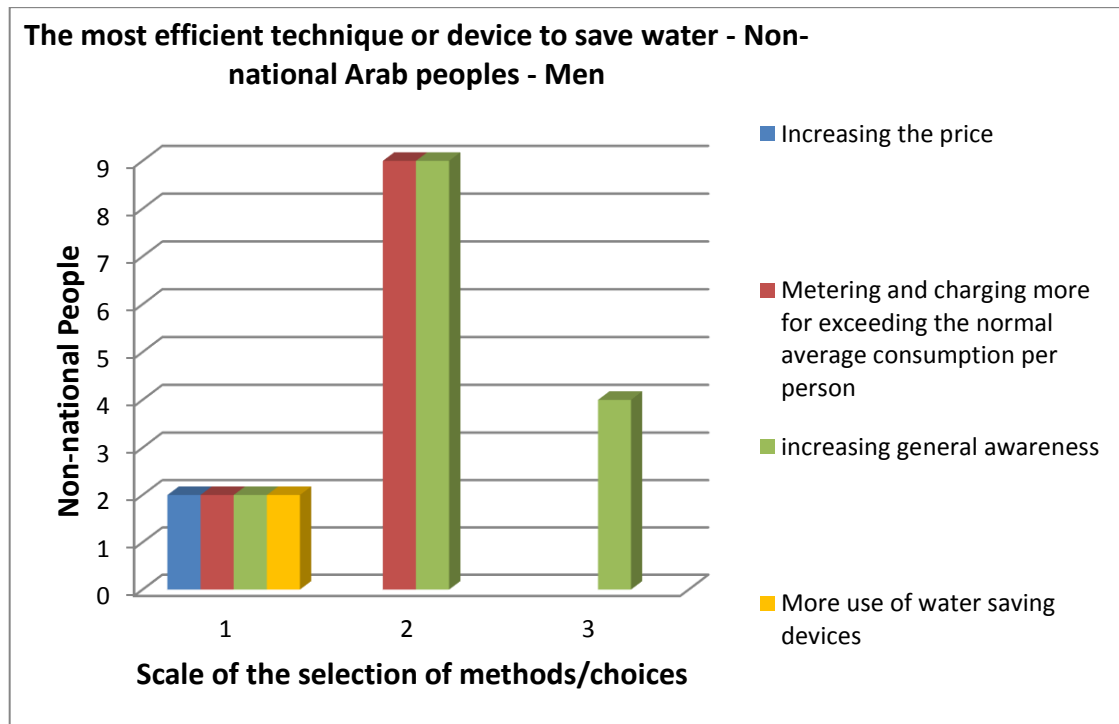


Figure 59: The most efficient technique to save water- Non-national Arab peoples - Men

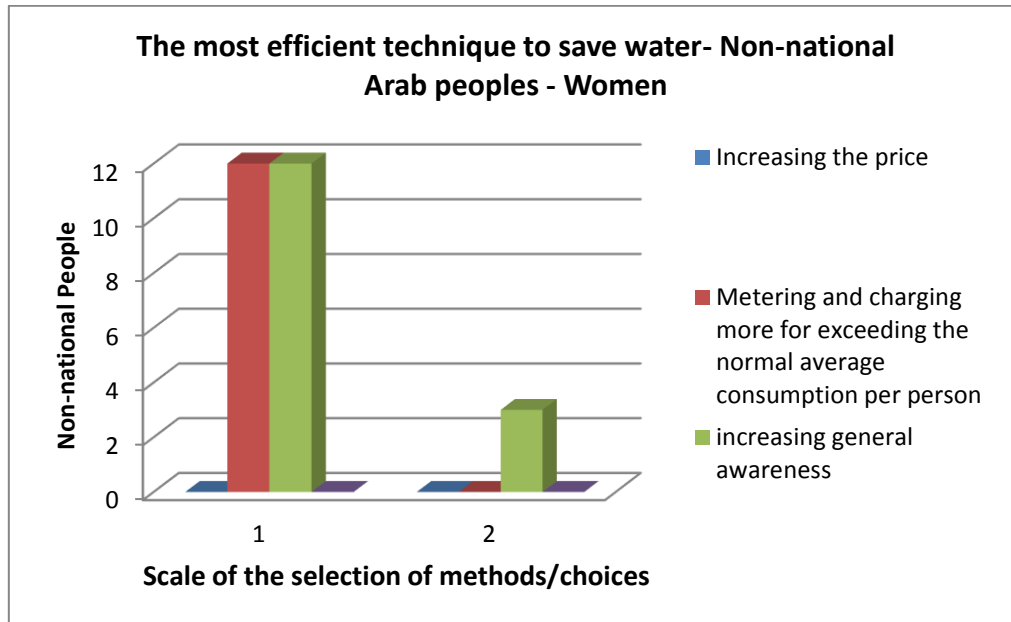


Figure 60: The most efficient technique to save water- Non-national Arab peoples – Women

Both of the figures 59 and 60 have shown that most of the non-national Arab residents believe that an increase in general awareness combined with water metering are the best methods. Higher charges should then be applied to those who exceed normal average consumption per person.

Non-national Arab peoples' views on the most effective public awareness campaign on water issues

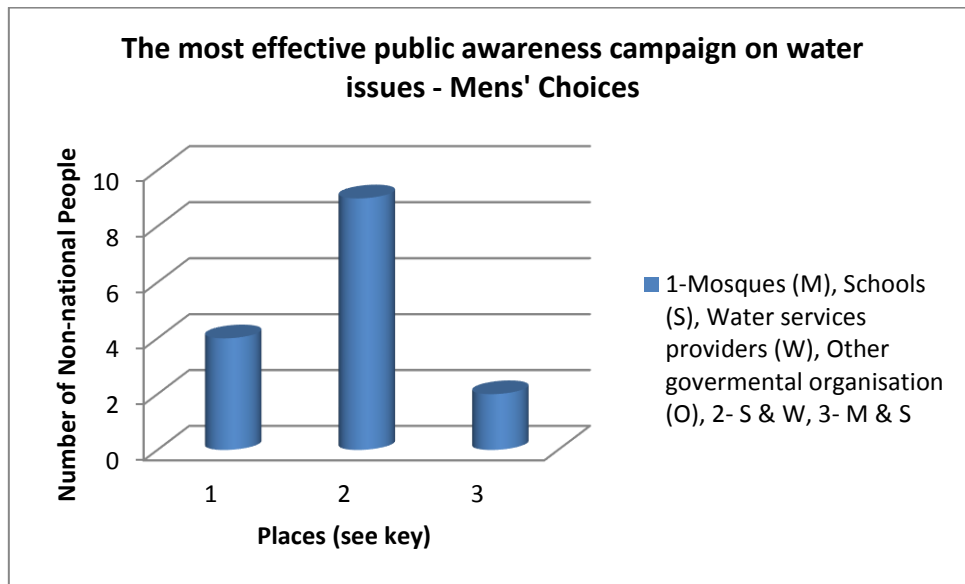


Figure 61: The most effective public awareness campaign on water issues – Men’s Choices

Figure 61 shows a difference in the trend that has been apparent in the data so far, in that non-national Arab men feel that mosques come second to schools and water service providers as the most effective choice to be a campaign provider.

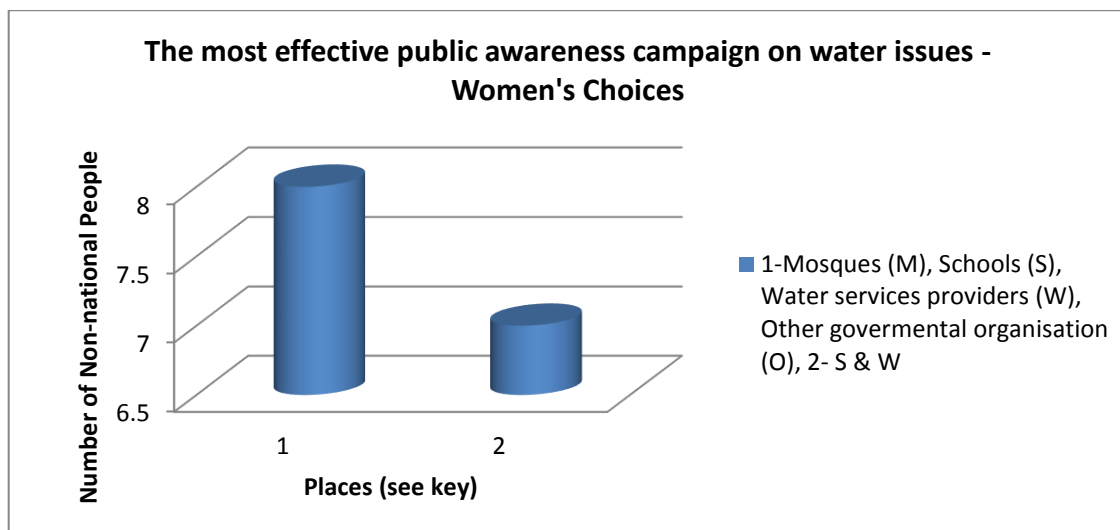


Figure 62: The most effective public awareness campaign on water issues – Women’s Choices

Figure 62 shows a return to the trend in which mosques are seen as the most effective providers of water awareness campaigns.

Non-national Arab people's reactions to water saving devices

Table 12: Non-national Arab people's reactions to water saving devices

Group A	I would never use		I already use it		I would use if it was provided free	
	Male	Female	Male	Female	Male	Female
Faucet/tap aerator (in kitchen or in bathroom)	3	5	0	0	12	10
Energy efficient Showerheads/ Water efficient dishwasher	5	7	0	0	10	8
Flush Less water saving displacement bag.	0	2	0	0	15	13
Leak detector dye tablets.	3	4	0	0	12	11
Group B	I would never use		I already use it		I will use and recommend it to others	
Low flush toilet	9	12	0	0	6	3
water saving dishwasher	3	0	0	0	12	15
Water Efficient Washing Machine (Horizontal-Axis Washing Machine)	7	2	0	0	8	13
Grey Water Recycling (Recycling water used for washing to flush toilets)	12	10	0	1	3	4
Rain Water Harvesting	14	15	0	0	1	0

Group A

Non-nationals' reactions to the Faucet aerator

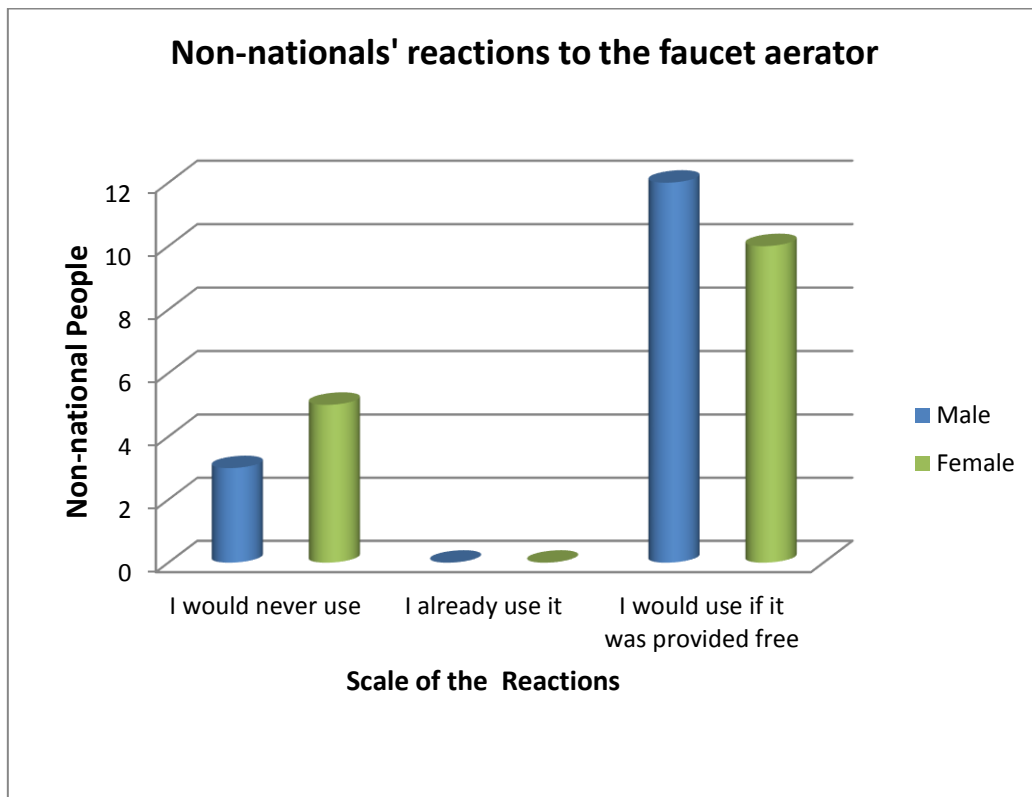


Figure 63: Non-nationals' reactions to the Faucet aerator

Figure 63 shows although no-one in this sample had actually used the device, the majority of them would be happy to use it if it were provided free.

Non-nationals' reactions to the Energy Efficient Showerheads/ Water Efficient Dishwater

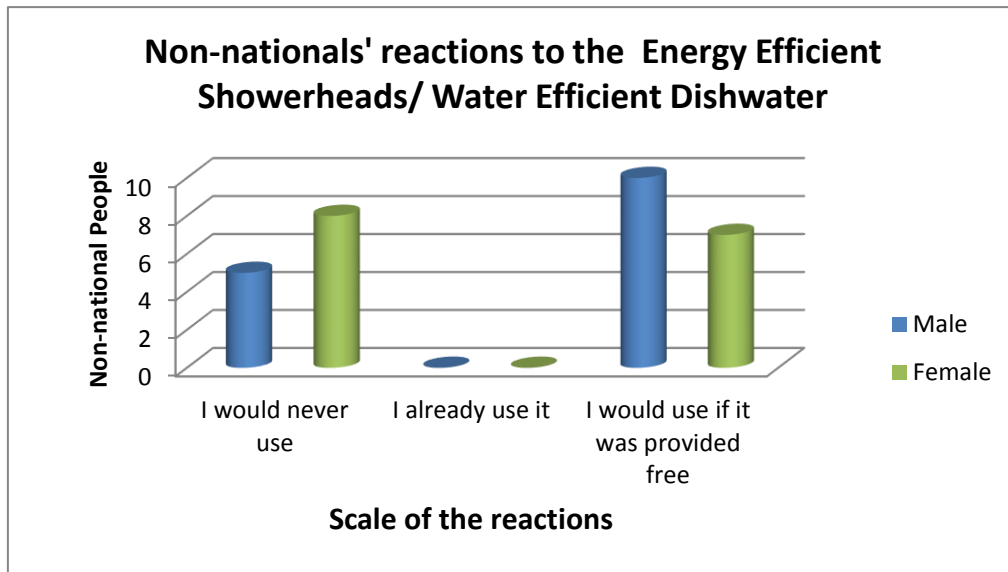


Figure 64: Non-nationals' reactions to the Energy Efficient Showerheads/ Water Efficient Dishwater

As in the previous graph, again although these devices had not been used, a majority would use it if it were provided free, however, a greater proportion of the sample also stated that they would never use it, so in this case there is less consistency in the responses than for the faucet aerator.

Non-nationals' reactions to the Flush Less Water Saving Displacement Bag

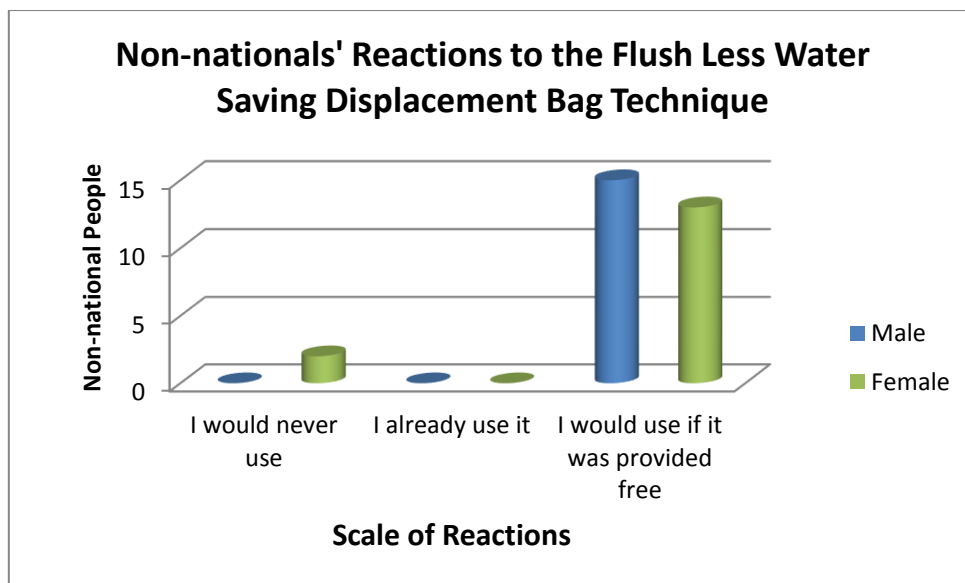


Figure 65: Non-nationals' reactions to the Flush Less Water Saving Displacement Bag

Figure 65 shows the trend continuing in that this focus group continue to show positive responses if the water saving devices were to be provided free.

Non-nationals' reactions to the Leak Detector Dye Tablets

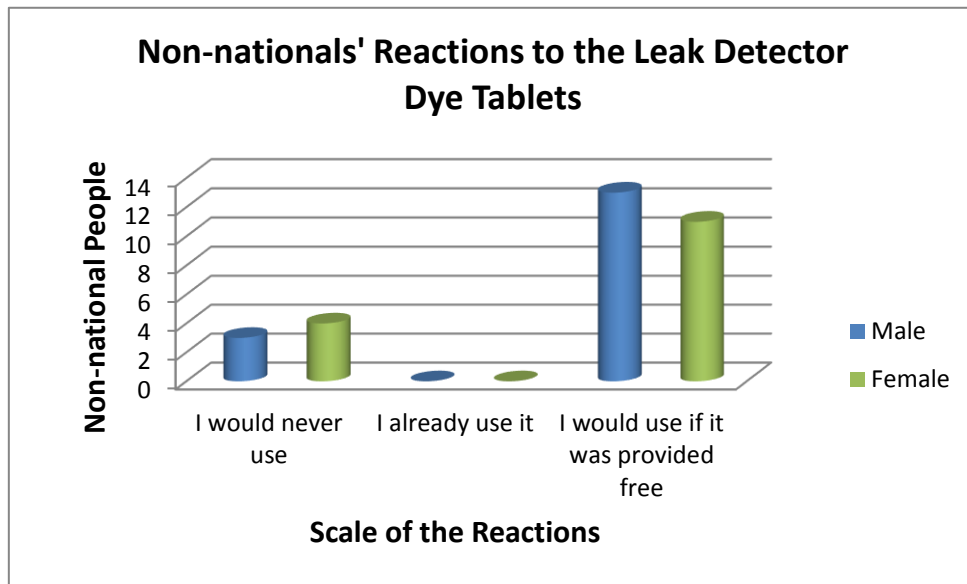


Figure 66: Non-nationals' reactions to the Leak Detector Dye Tablets

Figure 66 again demonstrates that although this focus group had not used the tablets, unlike the Saudi citizens, however they were prepared to try them if they were provided for free.

Group B:

Non-nationals' reactions to the Low Flush Toilet

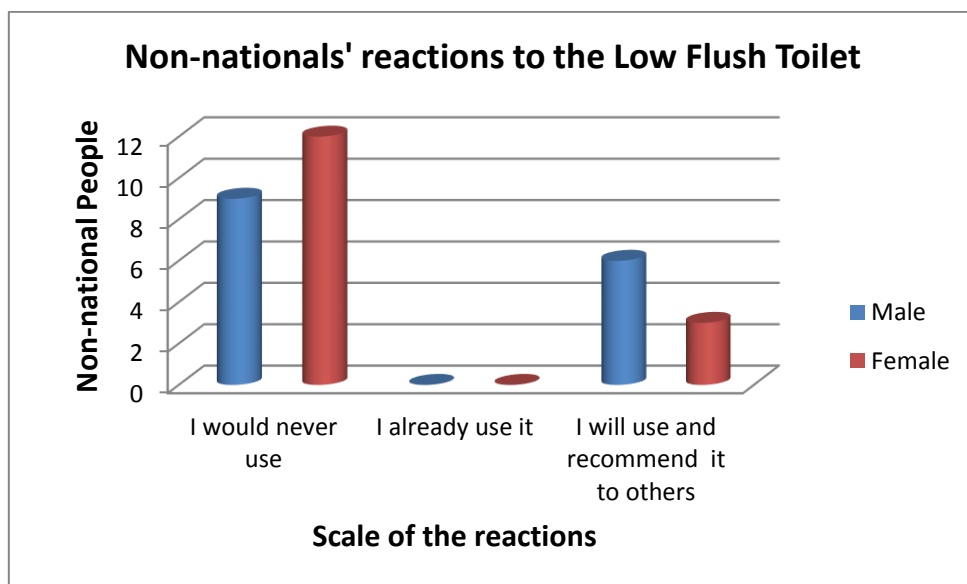


Figure 67: Non-nationals' reactions to the Low Flush Toilet

In this case, the pattern is different. Again, no-one in the sample had used it, but this time, less people would be prepared to use it in future, particularly women, which suggests an overall lack of knowledge about how much water is required for this household task.

Non-nationals' reactions to the Water Saving Dishwasher:

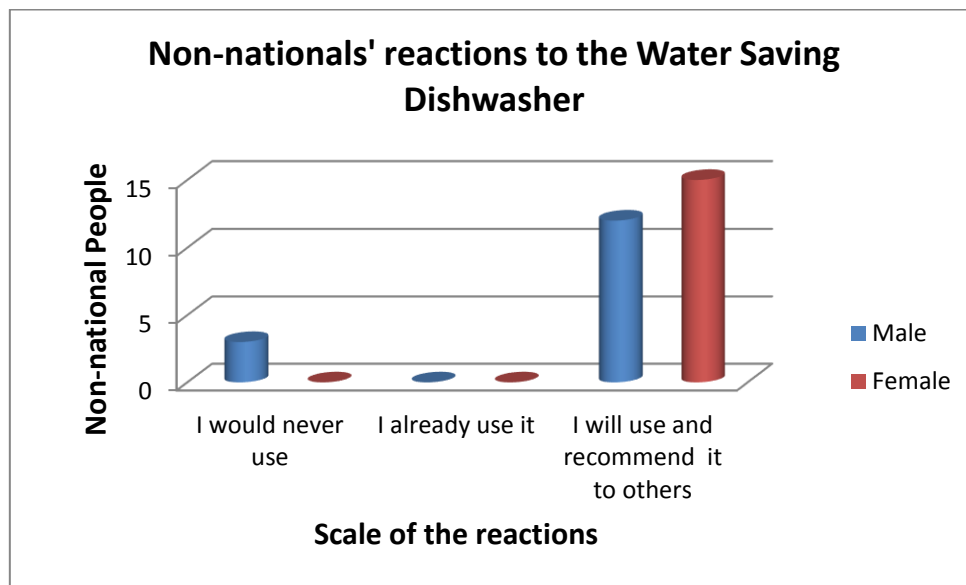


Figure 68: Non-nationals' reactions to the Water Saving Dishwasher

Figure 68 shows a very positive reaction to the Water Saving Dishwasher, a significant number were prepared to use this device. Like the low flush toilet, it is not a free device, but this did not seem to have any negative bearing on the result, so it could be a result of there being more general awareness of this product.

Non-nationals' reactions to the Water Efficient Washing Machine:

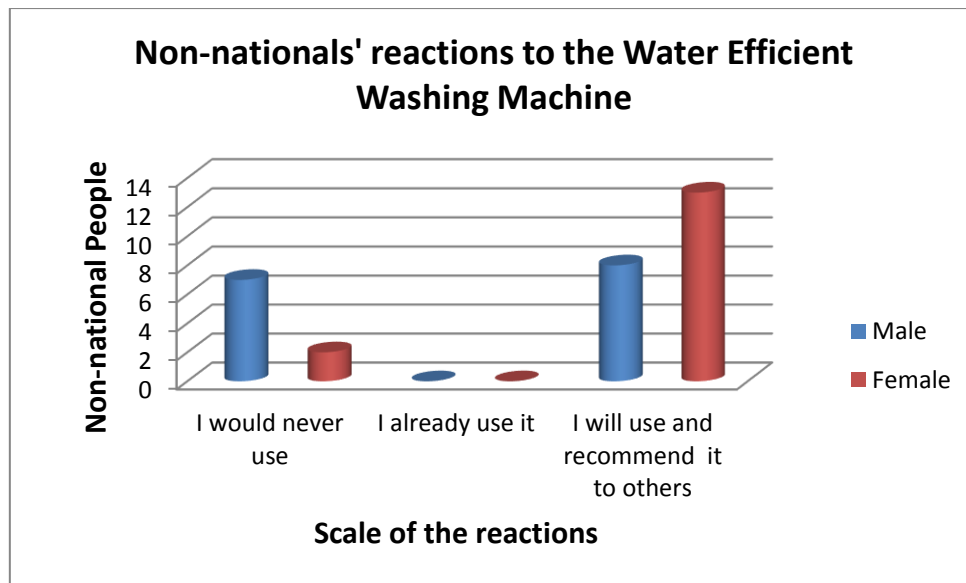


Figure 69: Non-nationals' reactions to the Water Efficient Washing Machine

The pattern continues in figure 69, it is notable that there is a slight increase among men in the intention never to use the device. Again, these are probably existing perceptions that could be challenge with awareness campaigns.

Non-nationals' reactions to Grey Water Recycling:

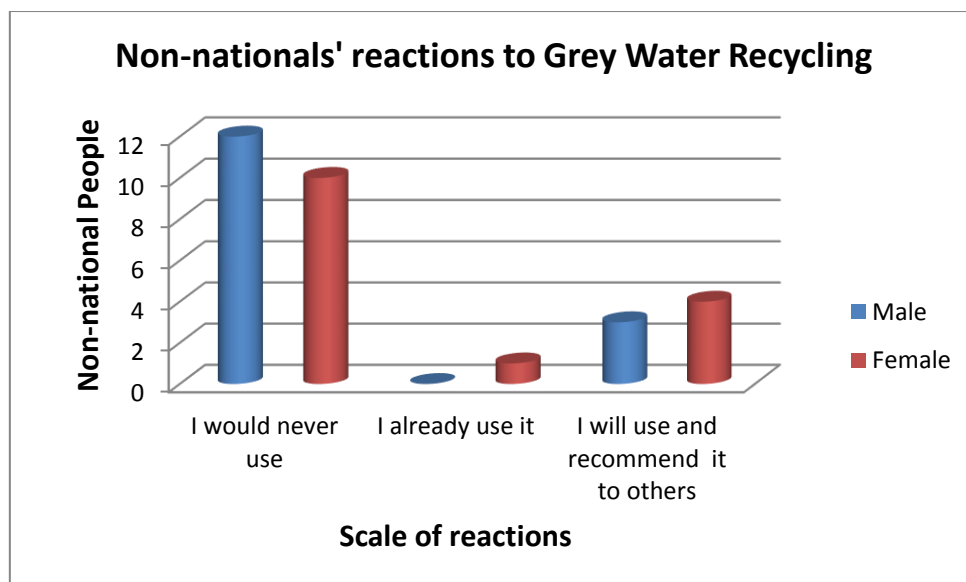


Figure 70: Non-nationals' reactions to the Grey Water Recycling Technique

In this figure 70, the use of grey water to flush toilets elicits a very negative response, similar to the results of the sample of Saudi citizens. There is an overall reluctance to reduce water use

with respect to toilets, so this is further evidence that there needs to be an awareness campaign about how much water is really needed for these tasks.

Non-nationals' reactions to Rain Water Harvesting:

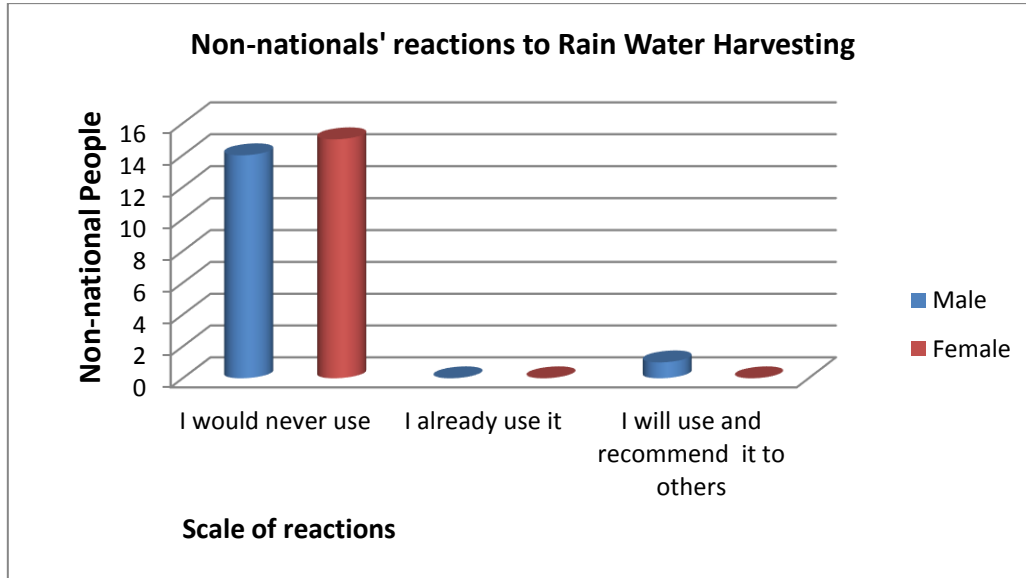


Figure 71: Non-nationals' reactions to Rain Water Harvesting

These results are similar to those of the Saudi nationals, in that water harvesting seems to be a cultural issue, which many people associate with the past and therefore no is longer relevant to everyday life. The exception in this case was an Egyptian resident; who knew that it is still practiced in traditional ways in Egypt (as he said in MarsaMattrooh (مرسى مطروح) in which the Arab Bedouins harvest the rain water by fixing small containers between rocks to collect rainwater which they then sell it to the local people, visitors and tourists).

Comparison between reactions to different devices: Group A and Group B

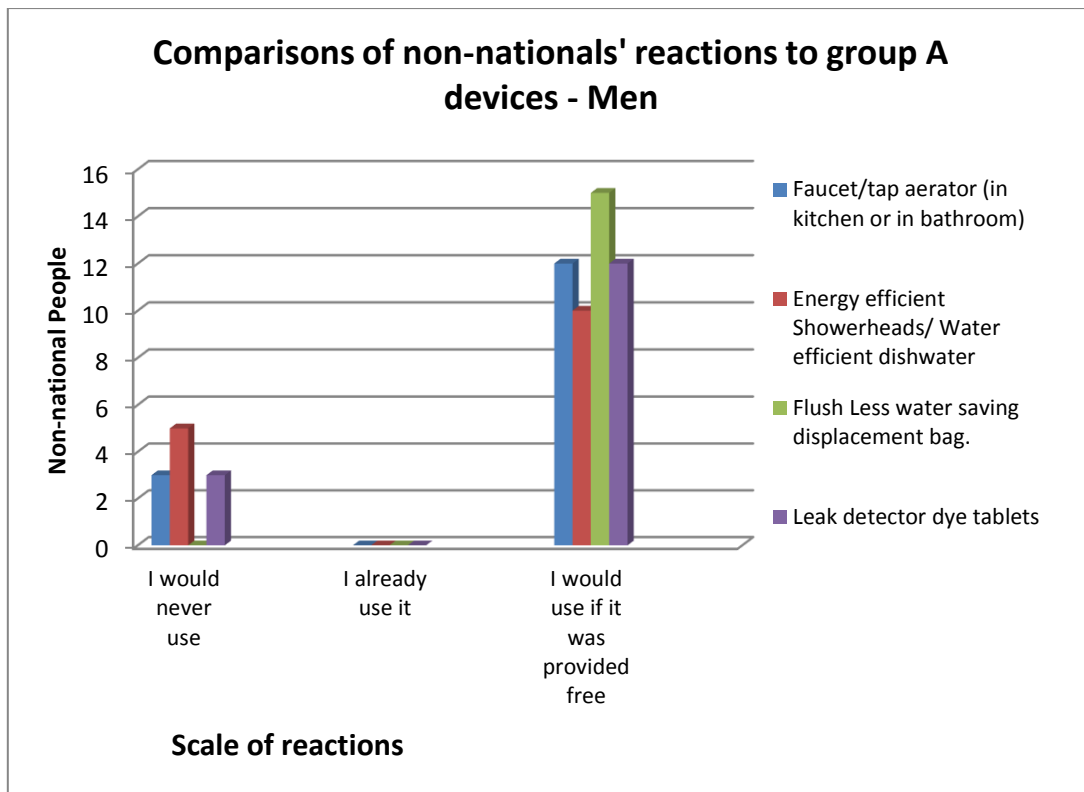


Figure 72: Comparisons of non-nationals' reactions with the devices in Group A - Men

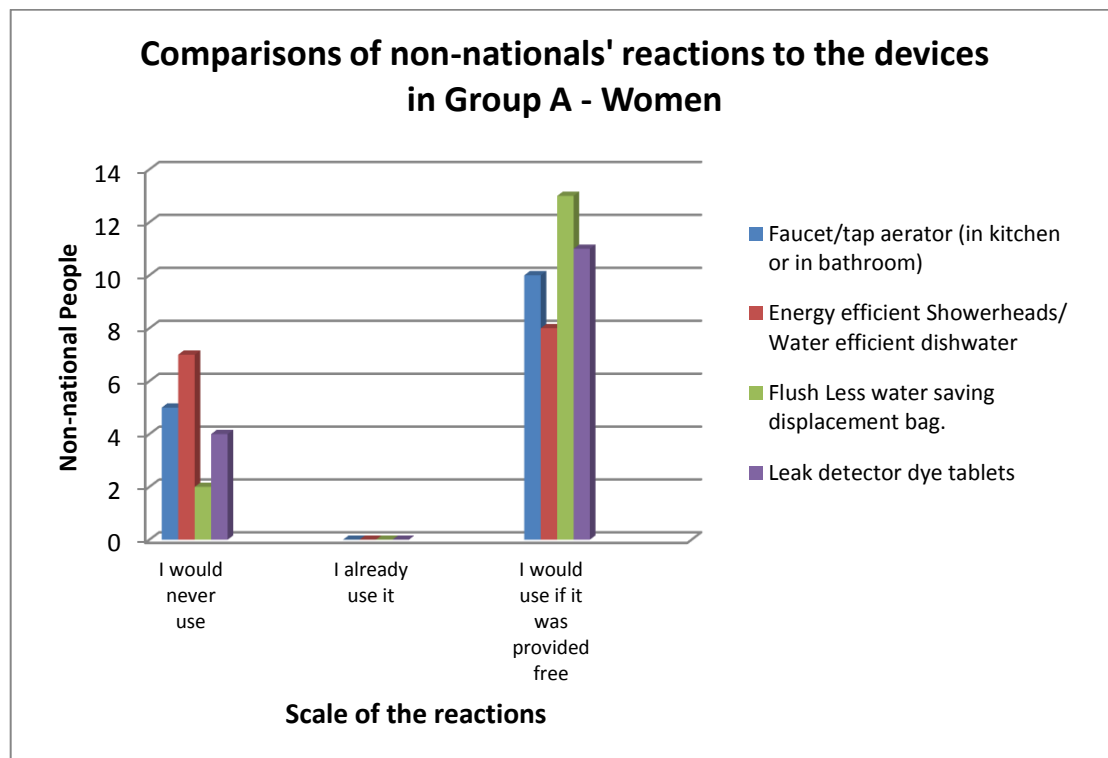


Figure 73 : Comparisons of non-nationals' reactions to the devices in Group A - Women

Generally, the reaction to the water saving devices in group A was positive, with most people in the sample prepared to try them, especially if they were provided free. There was a little more

reluctance among women however, particularly with respect to the shower head, as discussed in an earlier section. In group B, (figure 74 and 75 below) there is more enthusiasm for the dishwasher (women were also more enthusiastic about the dishwasher than the men) and as discussed previously, less enthusiasm for the low flush toilet, which could be addressed through educating people about the products; and little enthusiasm for the harvesting of rain water which the majority seem to see as no longer relevant to their everyday lives.

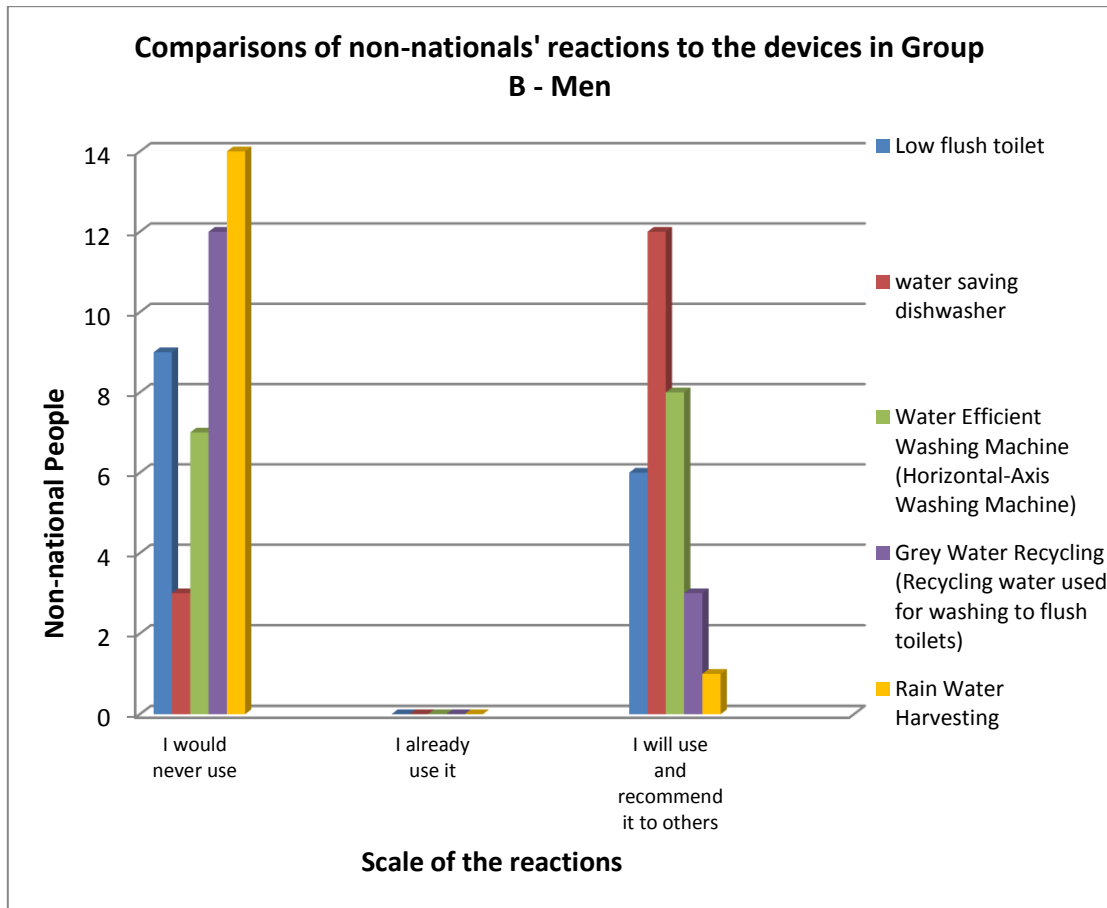


Figure 74: Comparisons of non-nationals' reactions to the devices in Group B - Men

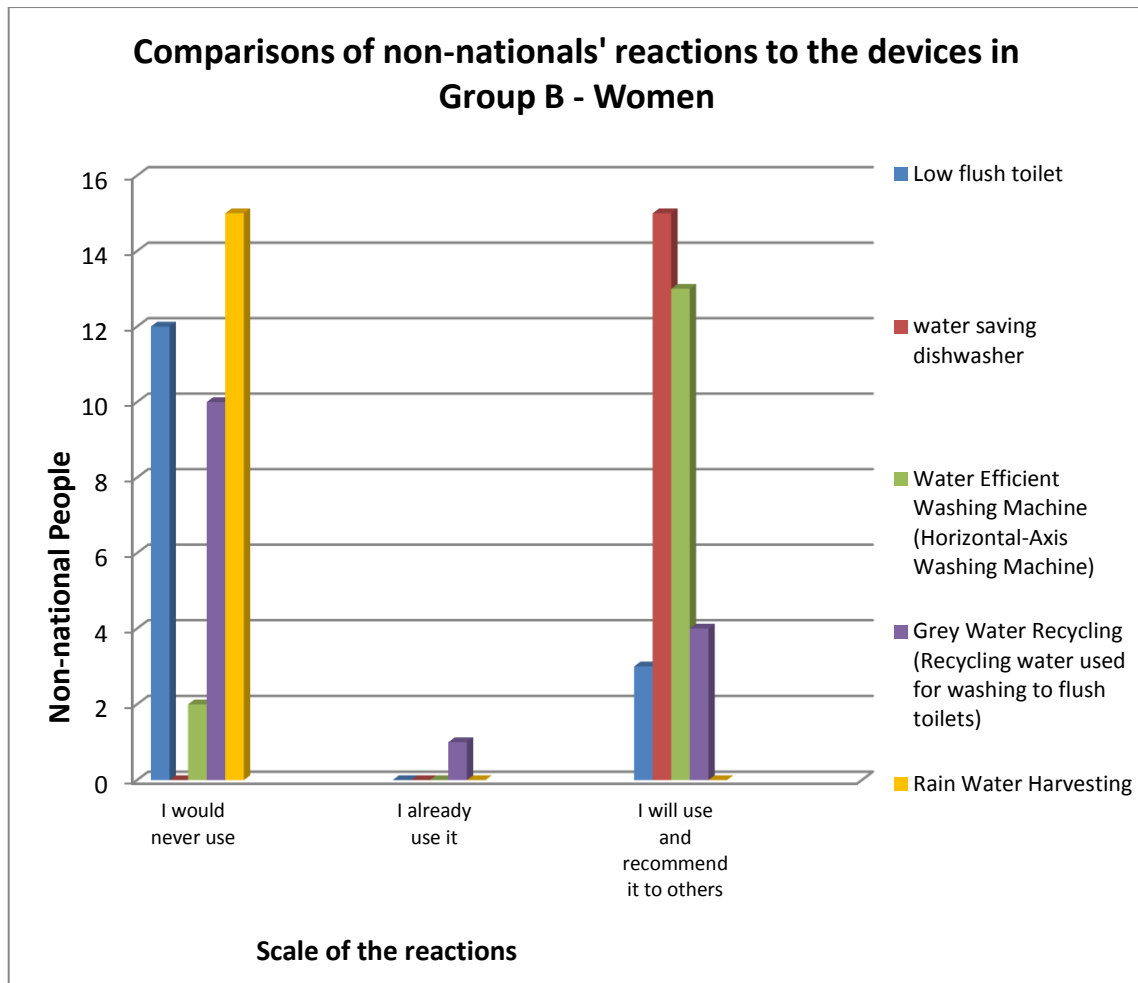


Figure 75: Comparisons of non-nationals' reactions to the devices in Group B - Women

What can be concluded overall, is that the data showed that members of the public from all the samples were concerned about water issues and future problems that may be faced. There are some levels of good awareness, particularly among women, but overall about half of the sample are not confident about their knowledge. This addressed the first sub research question and underlines the fact that awareness needs to be improved. It is however significant that the public themselves seem to show more confidence in their awareness than was afforded them by the stakeholders in the earlier discussions; and also some non-nationals perceive they have a good level of awareness.

However, in order to stimulate and harness engagement into actions (the final research sub questions), the public needs specific information, particularly about water saving devices and about how much water is really needed for household tasks. This may prove to have a positive

influence on changing behaviours. There is a willingness to learn, but not as yet a culture of full responsibility, particularly with respect to making individual efforts to conserve water. This could also be due to the fact that citizens who are not from the major cities and who see their supplies regularly interrupted, may not see themselves as an important part of the process of water provision. To this end, again IUWM is essential so that the supply can be improved and the whole population will feel that they are also stakeholders.

4.6 Summary and Main Findings

This chapter will reiterate the main concluding points from the data.

4.6.1 Teachers

1-The perception of students' level of awareness:

Responses from the 60 teachers (30 female and 30 male) indicate a spectrum of awareness levels by male and female students from no awareness, to weak awareness (more than half of students) to good awareness (very few students).

The generally low level of awareness was apparent to many teachers due to the existence of incorrect practices and behaviours, particularly in primary schools, with widespread extravagance (excessiveness) and lack of awareness about consumption levels.

Regarding a sense of responsibility, this was very low, hence teachers advised that the concept of responsibility should be instilled in schools, as well as a permanent commitment towards learning about water issues.

2-Teachers' thoughts on influences that affect the level of awareness

Islamic Religion: the Islamic religion influences the daily life of Saudi people and can raise awareness from a religious perspective.

The Family/Home influence: only a few teachers believe that families have a positive influence on their children awareness.

The impact of media: water lacks a media profile.

Although there is some awareness, it is insufficient in relation to the importance of water problems in the kingdom. The role of nursery education.

3-Perceived role of education/schools in raising awareness

The current situation of schools

The education system has not presented the water issues and its major problems clearly. There is also a need to address teachers' subject knowledge.

The role of education in raising awareness of water issues

Schools have a fundamental role in raising awareness because schools teach the parents of the future.

Education can play a significant role in raising awareness of both students and teachers, which can then educate families indirectly. This could include all types of employees whether teachers, administrative workforce or cleaners as education plays a key role in shaping the community consciousness.

This confirms the findings of other studies. *The United Nations Environment Programme (UNEP)* (2007) stated: 'education is critical for promoting sustainable development and improving the capacity of the people to address environment and development issues'; furthermore, education is stated to be an essential means of 'achieving environmental and ethical awareness, values and attitudes, skills and behaviour consistent with sustainable development and effective public participation in decision-making' (UNEP, 2007, Chapter 36). Teachers also confirm the importance of the primary stage, and describe it as stage of instilling values and principles.

The engagement of schools in World Water Day (WWD)

Schools did not react significantly with WWD and some admitted they were completely unaware of it.

Only a few schools engaged with WWD by organising special events. Generally the interaction in girls' schools was greater than in boys' schools.

4- Suggestions on how schools should raise awareness of water issues

Methods of raising awareness through the curriculum

The education system can play a vital role by including water issues in the curricula, but there is also a need to regularly update them. Water issues could be included across the curriculum, but are particularly appropriate in Science subjects.

Michael Little (1996), in his study about science education for environmental awareness in a postmodern world, confirms that: 'Science education has an important part in developing understanding of concepts that underpin environmental issues, leading potentially to pro-environmental behaviour.'

The role of teachers

Teachers need to improve their subject knowledge so they can act as a role model and talk directly to all students. There should be a partnership with the water services organizations in preparing the water flyers.

Monitoring students

Monitoring is required both in and outside school. Some teachers feel they should also use sanctions.

Pragmatic demonstration of the current condition of water resources

Field visits to water services providers and organisations can help to raise awareness.

Motivation to research water issues through extra curricula activities

An extra curricula focus to promote the research of water issues would be beneficial to high school students. Many teachers claimed they have no motivation at present.

Promoting awareness of water conservation

An extra curricula program is necessary here, including visits and demonstrations that could enable a school system of conservation to be set up.

The role of the media

The media should work in partnership with schools to use broadcasting to raise awareness.

5- Teachers' enthusiasm for schools to play a role in raising awareness of water issues in society

The majority of teachers demonstrated strong enthusiasm along with a sense of responsibility due to water scarcity in the KSA. Significantly water has an important role in Islam.

6- Cultural issues in the KSA that affect awareness raising

The aspects that facilitate awareness raising

Religion is the most important cultural factor because the KSA is a religious society. Many teachers pointed to the importance of combining water issues with teaching the Islamic religion, in terms of the Islamic optimal instructions, behaviours and practices.

Social media devices can also help to spread awareness.

Cultural centres could play a role such as the King Fahd Cultural Centre and King Abdulaziz Centre For National Dialogue in Riyadh.

The aspects that complicate awareness raising

Excessive amounts of water can be used for cleaning and water can be wasted in private swimming pools and leisure facilities. This is compounded by relatively cheap tariffs, which can make it difficult to appreciate the value of water.

7- The most effective public awareness campaign on water issues

Teachers from 60 different schools believe there should be an integrated awareness campaign involving several organisations: mosques, schools, water service providers and other government organisations. 95% of teachers rated mosques of high importance, even more than schools (86%). Water service providers and governmental organizations represented a total of 71.7% and 66.7% respectively, the relatively high scores emphasising the need for an integrated approach.

4.6.2 Water managers

1. Perceptions on the scope for more integrated urban water management (IUWM)

Water managers in the Ministry of Water and Electricity

Many are optimistic because they believe that the infrastructure works well already with the Ministry of Water and Electricity, the Saline Water Conversion Corporation and the National Water Company working collaboratively. The participation of citizens, particularly women is imperative. Some believe however that now is not the right time to implement IUWM because of a lack of organisation amongst consumers, particularly those in agriculture.

Water managers in the Saline Water Conversion Corporation(SWCC)

The SWCC do not feel that IUWM is their responsibility, but they work with other organisations to form an integrated strategic plan for the Kingdom's requirements for drinking water until 2050 AD, which will work to provide drinking water to all cities and provinces of the Kingdom. However, this campaign is stressing provision rather than management of existing supplies.

2. Perception of the level of public awareness

Water managers in the Ministry of Water and Electricity

They feel that current water awareness does not reach the desired and required level. Also there is no perception of the future risks as a result of neglecting water issues. The managers believe that non-Arab foreign workers (in particular domestic workers) lack awareness because they believe water is readily available in Saudi homes.

Water managers in the SWCC

A majority of them believe that the level of public awareness is low, but that people are beginning to use water saving devices, deal with leaks and advise each other about water issues.

3. The current water campaigns

Water managers in the MOWE

The MOWE has its own department of awareness and water consumption and almost half of the managers believed that the campaigns were successful through home visits. There were positive reactions in many sectors, because free water saving devices were distributed to citizens, governmental and civic organisations in Water Rationalisation packages.

On the other hand some believed they were not progressing quickly enough with respect to misusing drinking water through irrigation, and cleaning. Also, some farmers do not obtain permits for drilling wells, which contributes to the disruption of the aquifers.

Many managers feel people are not concerned about wider issues, but only about their own water supply, where due to frequent interruptions, people are known to dig underground reservoirs for their own buildings.

Water managers in the SWCC

Some managers saw the relatively good success of conservation campaigns in mosques, hotels and government associations, but felt that the campaigns did not influence a large number of citizens.

4. The extent of current attempts or perceived role of attempts in raising awareness of water issues

Most managers feel that awareness campaigns must be supported by effective legislation.

Some Managers see water scarcity as a global issue.

5. Water managers' suggestions on how public awareness of water issues could be most effectively achieved

Raising awareness requires a systematic approach across all sectors, whether in agricultural, industrial, civic or domestic.

6. Promoting awareness through Education/schools:

The Ministry of Education should work in cooperation with the relevant authorities to plan campaigns and include water awareness in an improved curriculum.

7. Attempt to access to all segments of society/public:

This could be achieved by coordinating with the mosques and with all appropriate government agencies, institutions and organizations; to utilise all possible means to make the largest number in society aware of water issues.

8. Focusing awareness on three kinds of consumers:

The Labour force:

Workers from overseas require education about water issues from their employers or sponsors.

The Major agricultural consumers:

Improved methods of irrigation must be developed and used, to reduce depletion of the aquifers. Farmers should be encouraged to avoid the export market.

Women:

In a partnership with the Ministry of Social Affairs, women could improve their own practice in the home and pass this on to their families.

9. Benefit from the experience of other countries:

Some managers refer to the UK, America, Japan, Australia, and African countries and believe it will be possible to adapt their initiatives to the KSA.

10. Raise the cost of water tariffs:

Some managers, especially from the Saline Water Conversion Corporation, (SWCC) agree the water tariff could be raised, or else it could be raised for higher consumers to encourage conservation.

11. The need to create a committee to manage water conservation awareness promotion

MOWE Managers

They believe that there is no need to create such a committee.

A few managers advocated regional committees that could be regulated by General Administration of Awareness and Rationalisation within the MOWE. They could be responsible for awareness campaigns and monitor consumption.

SWCC managers

In contrast there was strong support for a central committee led by the MOWE that should include relevant ministries such as the Ministry of Education and the Ministry of Culture and Information.

12. The extent of water managers' cooperation with governmental organisations

There is cooperation between the MOWE and the Ministry of Culture and Information to raise awareness but some managers believe it does not reach the required level. Water managers in SWCC argued that it is not their responsibility to cooperate with the Ministry of Culture and Information.

13. Cooperation with the global agents in the water field

The MOWE cooperates with the Global Water Partnership, the World Water Council, the International Water Association, the International Water Resources Association, the International Desalination Association and the Water Quality Association, but it has been argued that they do not cooperate effectively. Likewise, a majority of the managers in the SWCC regard global cooperation as inadequate.

14. Cooperation with the international water projects and programs

MOWE and SWCC collaborate with the following: the International Hydrological Programme (IHP) (via UNESCO), the World Water Assessment Program (WWAP) and the World Water Development Report (WWDR), but to a limited extent.

15. Communication with bottled drinking water companies

This is still relatively low in relation to the issue of raising awareness.

4.6.3 Water engineers

1. Engineers in the NWC - perceptions on the meaning of IUWM

IUWM has an economic importance in civil development and prosperity.

IUWM can manage water demand appropriately and can track future needs for water. It encompasses the water cycle starting from the main source of water, accommodating human use until the final disposal of used water after the treatment is discharged.

2. The extent of IUWM in the KSA

It is practiced in larger cities only. The infrastructure is not good enough for the full implementation of IUWM. There are inadequate budgets. The water sector lacks professional staff and the correct procedures for IUWM.

3. Perceptions of barriers and challenges to the future implementation of IUWM

Excess bureaucracy is still present in the water management sector. Managers also believe a 'mind-set' exists to create resistance to change.

Perceptions on how barriers and challenges could be overcome

Some engineers recommend an independent board be formed from the MOWE, the Ministry of Commerce and Industry, the Ministry of Agriculture, the Presidency of Meteorology and the Environment, the Ministry of Municipal and Rural Affairs, and the Ministry of Economy and Planning so that participatory decisions could be made.

Feedback from the Bureau of Experts at the Council of Ministers and the Committee for Water and Public Facilities and Services needs to be improved.

The principles of Value Engineering should be applied to complete overdue water projects.

4. Perceptions of the public awareness, attitudes and behaviours in relation to water issues in KSA

They are seen as relatively weak and consumers need to share a sense of responsibility with the water sector administration. There is no effective program of raising public awareness, which requires serious action from water policy-makers.

5.Perceptions on the need/possibility of creation committee to manage water conservation awareness promotion

A management committee to oversee conservation should be established involving water planners, commercial managers, education professionals, water professionals and environmental engineers

A committee could be formed for each city and work with related organisations.

6.Engineers' suggestions on how raising public awareness of water issues could be most effectively achieved

This should be taught first and foremost through primary schools curricula. Secondly, through media outlets. In addition, Friday Prayers could promote conservation. Competitions could be organised. A small number of engineers supported an increase in the water tariff.

7.Engineers feelings about taking account of the views of technical specialists in relation to IUWM from the water policy makers in MOWE

Many engineers stated that water policy makers in the Ministry of Water and Electricity are taking into account the views and suggestions (related to IUWM) of staff in senior positions only in the National Water Company.

Engineers judged that the level of consulting technical specialists in this dimension is still inadequate. In this regard, some engineers propose that it is beneficial to have a committee of technical specialists and consultants. This should be linked to the Board of Directors of the National Water Company, of which the Minister of Water and Electricity is the chairman, for submitting proposals to influence new decisions.

4.6.4 Lecturers

1. Perceptions on the main water issues in the KSA

Lecturers in Saudi universities indicate the following:

Unavailability of fresh water resources

Expensive water treatment techniques
Less adequate waste water treatment and reuse
No extra drainage system to deal with the storm water
Non-renewable groundwater aquifers
Excessive water use for agriculture

2. Perception of the extent of IUWM practiced in the KSA

All researchers agreed it was essential but underused, though there are some aspects in practice. There is a need to fully implement IUWM.

3. The scope for more IUWM in the KSA

There is great scope, but IUWM should be managed by one organisation or a Ministry who would be responsible for planning, management, distribution and supply, treatment and re-use of water. They proposed to unite all services in the water sector possibly under a Ministry of Water.

4. Perceptions of barriers and challenges that may challenge the implementation of IUWM

A common view was that scientific and research recommendations from universities and scientific institutions need to be implemented. In addition, there is poor coordination between the municipalities and the Ministry of Water in building the supply infrastructure.

At present there is little awareness of the management, recycling and re-use of treated water.

Desalination is very expensive due to high oil consumption.

5. Perceptions the level of public awareness, attitudes and behaviours in relation to water issues

Although there is water awareness at level of government, academics believe public awareness, attitudes and behaviours are limited. There is also a belief that public attitudes are self-interested, but could be improved by linking issues to the Islamic religion.

Others argued a culture of concern for water must be created in partnership with schools and other institutions.

Finally, there was a suggestion about giving farmers incentives to grow crops that did not require too much irrigation, or that regulations could be put in place to enforce water savings.

6. The level of the apathy or concern in the Saudi community

Academics feel that a large section of Saudi society are apathetic to the water situation. They suggest using media outlets and the distribution of literature to raise awareness. Religion can play a part in encouraging conservation. Additional legislation could enforce positive behaviours, or incentives could be offered such as prizes for participants in competitions.

On the other hand, a small number of researchers believed that the level of awareness is good on the whole.

7. Views on the need to increase public participation in decision making:

The majority of academics deemed this unnecessary and that governmental decisions were sufficient as long as they were applied firmly. The private sector on the other hand could assist decision-making with their expertise.

8. Views and suggestions on what marketing tools could be used to promote eco-friendly water saving products or devices

Advertising media and direct contact with the public including home visits could be used, in addition to social media and SMS. Products could be provided for free.

9. Views on the most effective public awareness campaign on water issues

These would originate from mosques, schools, water service providers and other governmental organizations, but especially mosques and schools.

4.6.5 Environmental managers

1. Perceptions of the meaning of IUWM

The environmental managers in the Ministry of Agriculture and the Presidency of Meteorology and the Environment agreed that IUWM is a process that oversees every stage of the provision of water, from source, to different methods of provision (desalination, purification, reservoirs, and aquifers) supply networks and waste treatment. IUWM encompasses economic, social and environmental water issues. It is a process that guarantees services.

To some managers, IUWM referred to the proper management of water sector with equal concern for conservation as well as the provision of drinking water.

2. Perception of the extent of IUWM in the KSA

Environmental managers in the MOA and the PME believe that the IUWM has become an urgent necessity dictated by the current water situation in the Kingdom, but it is only practiced partially and not effectively and the MOWE has too much responsibility. There are no standards or criteria applied accurately to measure water use. The success of water management is disproportionate to its level of government subsidy. Many areas do not have a suitable water supply. Thus, environmental managers believe that the application of IUWM can be improved as follows:

- Enacting more laws and regulations in relation to IUWM
- preparing plans for the future using the experiences of other countries in water management
- increasing awareness of citizens and educating farmers and the workforce
- Increasing accountability for negligent managers in the application of laws and regulations relating to IUWM and providing incentives to those who follow standards
- carrying out more regular maintenance work to the infrastructure
- providing water services equally in all cities of the Kingdom
- training employees
- working in cooperation with the MOWE, the ministry of General Education and the Saudi sports clubs to improve public awareness.

3. Perceptions of barriers and challenges to the future implementation of IUWM

Challenges related to the institutional dimension:

- The lack of specialists in water organisations.
- The lack of skills and training amongst staff in integrated water management.
- The lack of accuracy in some water studies in predicting future requirements of water.
- Too many governmental organisations involved in planning
- The awareness campaigns were not particularly effective and a large section of the public consequently do not have sufficient awareness.

Challenges related to the environmental dimensions:

- Scarcity of water.
- The geography of the KSA that complicates water delivery.
- Pollution from desalination plants.

Perceptions on how barriers and challenges could be overcome

- Long-term plans are required that take population growth, industrial projects and urbanisation into account,
- Look for solutions to existing problems,
- Take public water awareness into account.

4. Perceptions on the public awareness, attitudes and behaviours in relation to water issues in KSA

Water security is viewed as important at the governmental level.

At the individual level, public awareness is viewed as weak and does not show good practice. The media should be used to raise awareness, but this is seen as a short term. Regulations and sanctions are required to enforce good practice. Behavioural changes can also be encouraged by linking water to wider environmental issues.

5. Perceptions on the need to create a committee to manage water conservation awareness

All managers within the Ministry of Agriculture declared it was appropriate to form such a committee, across the agricultural, industrial or domestic sector.

Managers in the PME: Many supported the creation of a committee but argue it should be completely supervised by the MOWE. Some managers advocate forming sub-committees and a General Committee. A field of experts should investigate the problem of awareness amongst Saudi society. Campaigns should be led by the Ministry of Education, media outlets, and mosques.

6. The possibility of behavioural changes arising from the participation in water conservation awareness

The Ministry of Agriculture has had some success with regard to behavioural change, by highlighting behaviours that should be avoided and promoting environmentally-friendly water use.

Managers also agreed that international experience could be useful. Promotion of modern irrigation systems by the Ministry of Agriculture can play a vital role in integrated urban water management in terms of changing behaviours. The PME can encourage behavioural changes towards environmentally-friendly water use. However, some managers indicate that these plans need clear objectives. The PME has a media centre for promoting awareness about the importance of water and related environmental issues.

7. Perceptions on how to increase community knowledge about water pollution issue.

The Ministry of Agriculture look to the media, education and the family. The PME believe that environmental awareness campaigns will be effective. PME also look to the media. Pollution could become an issue of patriotism. More water treatment plants should be established to preserve the environment and reduce wastage.

4.6.6 Industrial managers

1. Perceptions on the company's awareness, attitudes and behaviours in relation to water issues

Aramco: The company deal quickly with water problems in industrial fields, residential areas and industrial cities. Managers note that the company adopts techniques to reuse water. *Aramco* educates its employees about the importance of saving water.

SABIC: It is felt that general awareness is adequate but requires further actions and initiatives. There are efforts to raise awareness and responsibility but these efforts are not achieving the required results. *SABIC* implements sustainability programs to keep down the costs for water which is required for their industrial processes.

2. Managers' perceptions about the role of Aramco and Sabic in raising awareness

Aramco: there is an enthusiasm about playing a part in awareness programmes and scientific conferences.

SABIC: there is more scope to contribute to awareness programmes and the managers feel the company has the ability to support projects and innovations in water management.

3. The success of current attempts to raise awareness of water issues

Aramco: the managers believe that current efforts to raise public awareness of water issues are worthwhile and that negative behaviours are mainly due to a lack of awareness.

SABIC: the managers are in agreement with *Aramco*. In addition they are concerned about the status of water security and its association with food security.

4. Perceptions on how current awareness, attitudes and behaviours could be enhanced by campaigns

Saudi *Aramco* and *SABIC* both believe that campaigns could be improved by developing well organised structures with which to distribute tasks effectively.

5. Industrial managers' perceptions of the meaning of IUWM

According to both companies, IUWM is an integrated process that optimises all natural and industrial water resources through effective management, in addition to reusing water and managing consumption.

6. Perception of the extent of IUWM

Both companies believe that IUWM is only practiced in industrial cities such as the industrial city of Jubail and that there is no integration of water services in the remaining Saudi cities.

7. Managers Perceptions of barriers and challenges to the implementation of IUWM

There are several obstacles or challenges facing the application of IUWM in the Kingdom as follows:

- The lack of awareness among the general public.
- The need to reduce the water wastage for agricultural and domestic consumers and the lack of a positive culture towards water.
- Incomplete infrastructure for the transportation, distribution and drainage network.
- Lack of integrated and organised management.
- The difficulty of obtaining new water sources
- Lack of adequate methods to take advantage of the seasonal rainfall.

Therefore, there is an agreement from all the focus groups that IUWM is not practiced effectively. Educational professionals and managers agree that there is a lack of awareness amongst the general public that must be addressed effectively. Members of the public however do show levels of awareness and concern for water issues, which will be a good starting point to stimulate public engagement as in research sub question three.

However, although the sampled members of the public showed a willingness to learn more about water issues, there was a contradiction in their behaviours, revealed in the data about their attitudes to water saving devices and recycling. Campaigns to raise awareness need to be targeted specifically towards these issues so that public engagement can be harnessed to produce positive behaviours, as in research sub question seven.

As suggested by the lecturers, a culture of water awareness is required, which will require the participation of all stakeholders. This can only be achieved through integrated urban water management, because the system is concerned with both supplying and conserving water, as noted by the water managers. In addition, water supplies should be fairly distributed to enable

all citizens to feel that they are stakeholders in the process and become part of the process. The process will as an outcome, harness engagement to produce action.

Having established, with reference to the sub research questions, that the full implementation of IUWM will be the process by which engagement will be promoted, harnessed and productive of action, a full discussion of this process (which will be termed a new paradigm) will be presented in detail. The data from the stakeholders within the Kingdom of Saudi Arabia revealed that many managers and academics believed that learning from the experiences of other developed nations would be vital for the successful implementation of IUWM. The next chapter will form a detailed analysis of water management in the United Kingdom and the potential of how this practice could make a contribution to a new paradigm of IUWM in the KSA, will be assessed.

4.6.7 The public

Saudi men and women

The Level of public knowledge in terms of water issues in KSA: Nearly half the sample did not show a good level of awareness.

Public views on the average total daily domestic consumption of water per person

Only 27% of Saudi men and 31% of women know it is 300-350 litres.

Public expectations on the percentage of the real paid cost of providing water by consumers

Very few Saudi consumers are aware that the government contributes 99% of the cost. An effective campaign to raise awareness would address this and the above two points.

Public views on the most efficient methods to save water

The most efficient technique to save water is to increase general awareness, followed by the increased use of water saving devices. Men particularly were not keen on increasing costs.

Public views on the most effective public awareness campaign on water issues

The majority of men and women look to mosques, but women also look schools in particular.

Public reactions/tendencies with the water saving techniques inside homes

Group A

The public would be prepared to use the aerator tap if it were provided free.

The Energy Efficient Showerheads and Water Efficient Dishwater/dishwasher for saving water were less popular, with half the sample claiming they would not use them. There is a reluctance to economise on water for bathing and showering.

Most consumers had never used the Flush Less Water Saving Displacement Bag, particularly women, although more than half of the men welcomed using the technique, if it were provided free, but the same was not true of women. A lack of knowledge about quantities of water needed for household tasks is evident.

A majority of Saudi citizens would not use the Leak Detector Dye Tablets because they were felt to be irrelevant.

Group B

More than half of the sample would not use the Low flush toilet. However, more than a third of the remainder would try it.

More than half of the sample would be willing to use the Water Saving Dishwasher and recommend it to others. Although another third would not use it, particularly among men.

More than a third had used the Water Efficient Washing Machine (Horizontal-Axis Washing Machine) and more than a half would adopt the technique.

The use of grey water recycling to flush toilets at home would not be used by the majority of people sampled.

Harvesting rain water attracted almost no response and this can be seen as a cultural issue.

The majority of people see it as no longer relevant and not their responsibility.

Arab non-nationals in Saudi Arabia

The Level of Knowledge in terms of water issues in KSA

On the whole, with a few exceptions, they consider themselves well informed.

The average total daily domestic consumption of water per person

Approximately half of the men questioned knew this. The majority of women were also correct.

The percentage of the real cost of providing water by consumers

A minority are aware that the cost to consumers is 1%.

The most efficient methods to save water

The majority of non-nationals believe in campaigns to raise awareness, the use of water meters and higher charges for higher users, but not to increase the price for all consumers.

The most effective public awareness campaign on water issues

Men feel they should originate only from schools and water service providers. Women believe they should come from mosques and schools.

Reactions with the water saving techniques inside homes

Group A

None had used the devices, but the majority would consider using all of them if they were provided for free.

Group B

Again, none of the devices had been used before.

The Low Flush Toilet had a negative reaction particularly from women. No-one had used it before.

There were more positive reactions to the Water Saving Dishwasher and the Water Efficient Washing Machine (Horizontal-Axis Washing Machine) and most would recommend it to others.

As with Saudi nationals, the use of grey water had a negative reaction with the majority stating that they would never use it.

Rain Water Harvesting had very negative results, to similar the Saudi citizens' data.

4.6.8 The discussion towards the aim of the project and research questions answered

This section drew the discussion towards the aim of the project and research questions answered. The main focus of the study as earlier stated was to determine the extent to which Integrated Water Management in Saudi Arabia can be enhanced by positive stakeholder/public participation and public awareness. The question has been answered through the analysis of surveys with samples drawn from various population levels.

The findings present that there is a need to develop stakeholders' knowledge by increasing current understanding relating to IUWM in the institutional, educational, environmental, industrial and social fields/sectors. In order to achieve that the process will occur optimally through building a strong foundation for collaboration within the water sector to encourage Saudi society to participate in the implementation of IUWM. This should be partly based on positive public participation resulting from high public awareness of water issues.

To entirely address the research question, it was vital to break it down into sub questions for greater focus. As indicated earlier, some of the sub questions focused on the current level of public awareness of water issues as well as the likelihood of public engagement. To provide answers to the question about the level of awareness, a sample from the public and social level was used to provide the necessary information required regarding the current situation of public awareness of urban water issues in terms of attitudes and practices. The level of awareness was also investigated at the institutional and industry levels where awareness was considered in relation to the ability to engage with the public.

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Chapter 5: The United Kingdom experience and its relevance to the practice of IUWM

The researcher has investigated 14 UK water companies and the following five companies were selected to do interviews with their water efficiency manager. The selected companies were categorised anonymously in this research as follows; Company A, Company B, Company C, Company D and Company E. It is worthwhile to consider looking at the overview of campaigns to raise awareness from the 14 different water companies in the United Kingdom (see appendix 10, an evaluation of the campaigns where sufficient data has been provided). Throughout this chapter, the question of how relevant this information could be with respect to the Saudi situation will be considered. The evaluation as to their potential effectiveness is also linked to the sub research questions for engaging the public and producing action. This research is important because the UK companies are successful in raising water awareness even in a country where there is a lot of rainfall. Knowledge of their practice will be useful to planners of future campaigns in the KSA. The data was gathered via a series of interviews. As stated in chapter 3, the interviews were carried out personally by the researcher.

In this chapter, detailed analysis and comprehensive data will be presented in the form of interviews with managers from selected water companies.

5.1 Interviews with UK water managers

The Analysis of the UK water managers' interviews

After looking at (the section presented in appendix) the overview of UK water companies, with brief suggestions as to how these campaigns may be adapted to encourage engagement and behaviour changes in the KSA. These suggestions were made with reference to a perceived lack of public awareness. The suggestions were also referred back to the research sub questions about engaging the public and producing positive actions and behaviour changes. In the following section, suggestions as to how these campaigns can be adapted will be explained and summarised more fully in a separate section.

Five companies will now be discussed in detail, and the analysis is on the listed categories and topics.

1-Number of campaigns carried out:

They vary according to the type of campaign carried out and what information they wish to convey to consumers. Company A has conducted the highest number of over 20 campaigns, but the other water companies did not provide a specific number. For company C, the precise number of campaigns is not clear; however the company has increased the number of campaigns carried out over the last five years. Similarly for Company D there is no definitive number of campaigns. Company D highlights 'water efficiency programmes' that the company has been running for the last 10 years, in five year blocks . Company E has run seven different initiatives and finally Company B does not specify the number of campaign's conducted over the last 10 years.

2-The aim of campaigns:

Each water company has a different campaign focus depending on various factors such as the unique geography of the area, water stress, governmental and industry regulations, the promotion of water efficiency, educating children and the type of customer households they serve across the UK.

Company A

For Company A , it is important to deal with the issues of water stress within the area, thus the primary aim of the campaigns is to make the public aware of water efficiency and secondly to increase awareness of their own water use and the benefits of saving water . Furthermore, to make customers more water efficient involves persuading them to change their behaviours to save water in homes and businesses. Daily water use, for example in the kitchen and the bathroom, is an important focus as these are often unconscious actions that need to be challenged. The public perceives water as a cheap, plentiful resource which they do not have to make time to think about. Thus Company A is aiming to raise awareness in order for them to make proactive decisions to become more water efficient. We can draw the conclusion that this could be equally applicable to the water situation in Saudi Arabia where the water authorities cite water awareness as the first step to making changes in customers' behaviours.

Company B

For Company B, the Ofwat regulator targets, that were set four years ago, set the tone for the campaigns. The overall aim is to save water and raise awareness for customers. For the water company the aim is to gain a better understanding of how to communicate the campaigns to different types of people. The company uses Acorn categories, which is a measure of grouping people by household income, which helps to direct campaigns to relevant social groups. They believe that each campaign should contain a positive message. Company B is using energy as the link, because water is cheaper than other utilities. Energy savings are promoted as being important as money savings in persuading people to use water saving devices. This process is dependent on a culture of energy saving, which exists due regular increases in gas and electricity tariffs.

Another main theme for Company B is the education programme where trained teachers visit schools in the region to educate children in lifelong good practices. It is hoped the children will take the water saving messages home to parents and influence their behaviour. They believe this represents the next change in attitudes towards water which will be analysed through feedback from the schools who participated. Thus the aims and themes are related to the company's present aims: current savings and long term goals for efficiency. Again, we can draw the conclusion that this could be applied in Saudi Arabia where local water companies are looking to interact with young children to educate them about correct water behaviour and inform them of good practice.

Company C

For Company C, the aim of the campaigns was also to save water by making changes to everyday actions. The company's website provided advice on water saving devices and offered advice on changing behaviours, for example by having a shorter shower or not leaving the tap running. Thus the aim of the campaigns would be to convey a particular message.

Company D

For baseline water efficiency campaigns, Company D aims to provide information about water saving products to customers, although there are no wide-scale programmes. One of the aims is to provide a free home visit and a retro-fit where an Company D employee visits the customer to carry out a water audit and then installs products to reduce water consumption. The regulator sets the water saving targets for the five years, thus the aim is that within certain areas of Anglia, some customers are eligible for a free visit, water audit and installation of products. This is a course of action that the water authorities could consider, as consumers have indicated they would try water saving devices if they were provided free.

Company D interviewee also cites behaviour changes in discussions about saving hot water which depends on the link between water and other forms of energy. Ultimately the aim is to persuade customers to embrace the products that save water and to change their water-related behaviour.

Company E

For Company E, the campaigns aimed to raise awareness of why it is important to conserve water, to practically and physically cut consumption and to link water consumption to the natural environment. For example one of their major programmes is the 54,000 domestic home visits carried out by the company which involves visiting households, talking to customers about water efficiency and demonstrating products to reduce consumption of taps, showers and toilets.

Planning and designing campaigns

Each water company has a specific way of planning and designing water-related campaigns, which involve small scale campaigns to large scale programmes involving thousands of customers and in some cases, businesses. Campaigns can also be designed in collaboration with external partners such as local authorities or charities to meet the specific needs of different customers. The water authorities in KSA would need to significantly increase their work with partners in order to plan large scale or national initiatives.

Company A

Company A has modified their water efficiency campaigns over the last five years as they seek to achieve a better understanding of their target audience. The message is targeted at a particular audience, but now they carry out fewer traditional campaigns, such as mass leafleting. Company A is thus attempting to change their campaigns by personalising the information so that it is relevant to the needs of different customers in the home and businesses.

An example would be to reduce the time spent in a shower, which would save X number of litres of water a day and a year. Thus if this is achieved by a family of four, this would amount to a benefiting of the local environment and reducing the overall energy bill. However, not all members of the public are aware that water use contributes directly towards energy bills. This is because some domestic users have not yet been fitted with water meters and, as stated before, water tariffs are comparatively low. Thus Company A has worked on integrating water and energy together in their campaigns. They consider the target audience first in order to make the campaigns relevant to specific types of households and businesses.

If the message in the campaign is tailored to the needs of the customers, then it is more likely to be received by them. If the company can demonstrate to customers that water efficiency can reduce their energy bill, it might make people more likely to practice water efficient behaviours. Thus the design of the campaign is integral to meeting the needs of the target audience. The use of wide scale media may not necessarily match the needs of the company. Therefore if they want to focus on a particular area or type of audience, Company A will work with external partners. This includes housing associations, local authorities and businesses to design campaigns using local networks to communicate the message to the intended audience. This form of campaign would require large amounts of data from the public and it would be essential for the Saudi water authorities to undertake this work prior to planning any campaigns.

Company B

Company B has designed various campaigns including those advertised on the sides of buses with visual messages with captions such as 'Would you waste this much water if you had to

carry this home?' showing pictures of people carrying water in buckets. They have also advertised on the back of car park tickets in addition to their own website where customers can find information relating to saving water. For example there is an online calculator which can be used to calculate how much water is used at present and this figure is used to calculate future usage. They also provide customers with free water-saving products. As the free provision of water saving devices is taken so seriously by the UK water companies, it suggests that it should be investigated by the KSA water authorities, especially as the new data of this research as shown evidence that it should meet with a positive response.

The company also plans to conduct water efficiency campaigns by working in partnership with other businesses. They currently work with Home serve who carry out home visits to make central heating repairs. Whilst they are in the property, they can carry out a quick water efficient survey, check the levels of water use in the property, and fit water saving devices. This is proving to be one of the most effective ways of saving water.

One of the main motivations behind the campaigns is to encourage good practice in children at an early age, so as to embed these behaviours for life, at an age where they are usually open to new learning. With adults it can be challenging to change long established routines and it would cost the company a lot of time and money to invest in changing behaviour in every member of the household. Therefore focusing on changing children's behaviour is a more economical approach. Adults however are more likely to respond to free incentives such as tap inserts or water saving showerheads, as long as these products are durable.

Rather than give products away that may not be used, Company B are focused on getting into homes and businesses to install water-saving products and to educate people about water efficiency. In order for the company to design campaigns more effectively, they need to understand the needs of their customers because one group can be vastly different to another. Careful targeting is probably easier with a network of regional companies rather than central planning, so regional committees (supported by some industrial water managers in the KSA) could be set up to gather data and target campaigns.

Company C

Company C state that the planning and design of the campaigns would depend on the nature of the campaign and whether or not the company would work in partnership with other organisations. For example they have worked in partnership with the Dental Association where the campaign involved people brushing their teeth for two minutes whilst also turning off the tap for two minutes.

The campaigns are also dependent specific geographical areas, and how water could be reduced in a particular area. Another factor the company would consider is the time of the year. Campaigns in the summer would revolve around people not using hosepipes, or in the winter, asking customers to check their pipes. Thus in planning and designing the campaigns, the company would work in partnerships with external organisations in order to take into consideration the customers' needs. Campaigns would also be influenced by experts who would have a better understanding of the different customers and what would work best for them in terms of raising awareness and modifying water behaviours.

Company D

Due to the fact that Anglia is a comparatively dry region within the UK, campaigns were planned to make customers more water efficient by reducing demand. Linda described how the alternative would be to build new reservoirs. This would take as long as 20 years and was not seen as a feasible option. Reduction in consumption was the preferable course of action.

The company has recognised that customers may have a particular 'mindset' in relation to water-saving behaviour in that once water saving products are installed; there is a tendency to step back and take no further action. However Company D interviewee makes an important point about combining the interventions with promoting changes in behaviour. Customers must be told all the relevant information about saving money and water after product installation. It is also important to inform them they can potentially make further changes in their water usage

so that they can be put in control of the situation. This combined strategy has been most effective in changing behaviours.

Company E

Company E has planned campaigns in response to the water regulators recommendations to cut consumption because the South East is a water stress area. This has involved large scale metering. Metering also ensures that customers see that they pay for what they use and as a result, they will be interested in conserving water.

In relation to the design of the campaigns, Company E considers education to be an important resource for the future. They have also looked at grouping customers based on different levels of income, as engagement with water saving will help families on a lower income to meet their bills.

3-Evaluating campaigns and the Level of participation

Company B believes it is important to evaluate campaigns to assess their impact. In the education programme, this is in a questionnaire format for teachers and pupils to complete which was conducted both as a learning exercise and to ascertain whether the messages have been getting through to students and to the right people. This occurs over a 12 month period:

- How many people did you target usually in your campaigns?

1. Company A

Company A might target several thousand customers in a district metered area (DMA). Water use is monitored on one meter on the network that supplies 1,000 domestic homes, therefore those 1,000 homes would be targeted with leaflets or letters. During times of water stress all customers would be targeted through mass media such as newspapers and the radio.

The company targets mainly families, which provides opportunities to help save water through reducing leaks, using water efficient devices and looking at customer behaviour. Usually campaigns engage households, but over time they also target businesses. Vulnerable

customers would also be engaged such as those on low incomes and those with larger families who would may require assistance to reduce their bills which would normally be higher than an average family household.

2. Company B

Acorn data organizes customers into groups based on their characteristics, for example income. The company can then target customers more effectively by changing the content of their water-saving messages.

3. Company C

Across the region, Company C serves three million people. In general, campaigns would be targeted at households in specific geographical areas.

4. Company D

The water efficiency campaign has invited 87,500 customers to participate and has been running for the last 5 years.

5. Company E

The metering programme has required 33,000 customer home visits in the last five years in which 166,000 water saving products have been distributed and fitted in households.

What kind of participants did you engage in the campaigns?

Company A

In addition to households and families (as reported above) Company A also engages with industrial companies as major users, through account managers who take care of a key account. The campaign can then be targeted towards the key account holder. These campaigns can involve improving water billing, reducing trade waste, and finding different ways to get better value out of water services.

Company B

The campaigns are all based on the company's customer base. For the education based programme, the teachers engaged with 70,000 children in the first year, which over four years rose to 300,000. Severn Trent aims to more than double this figure over the next five years to engage up to 800,000.

Company C

Although the company is trying to engage with as many people as possible, younger participants are targeted in campaigns such as the Schools Education programme for 7 to 8 year olds. Participation could relate to a geographical area or it could involve specific households.

Company D

The campaigns based on a water stress map issued from the Environment agency which pin pointed specific areas to target. Company D then based their campaign on customers residing in those water-stressed areas.

Company E

The company engaged with customers on low incomes who could be entitled to benefits. The campaign helped customers' access £1.8million worth of benefits.

4-The effectiveness of campaigns in general- How successful were the campaigns?

Company A

The Company A interviewee provides an example of a successful campaign. During the drought of 2005-2006 in South-East England, water companies worked collectively on a large campaign called 'Beat the Drought'. There were also hosepipe bans in place and other media sources such as newspapers, radio and TV adverts were used to support the campaign. It was found that the overall water consumption during that period reduced by 7- 14%. However it is unclear how much of that water reduction was due to the campaign, the hosepipe ban or the use of media.

The campaign was successful and therefore the company will continue to communicate through those channels during periods of non-drought. They conclude that is better to continue talking about conservation and efficiency, so that water consumption can be reduced in the future.

The success of the campaigns depends on effective communication with the public. It is important to have an open and honest dialogue with the public, particularly when problems arise, to give them pragmatic advice on improving behaviours and how this will benefit the customer in the long run and also where they can find support.

Company B

Company B believes their educational campaigns are very successful because they help to achieve long-term water efficiency gains. The short-term campaigns using images on buses and messages on car park tickets are not believed to be as effective as they are limited to a certain time period. The company believes people would inevitably go back to their previous behaviours if they were targeted with short term campaigns. Instead, the aim is to achieve long-term water efficiency over a period of ten years to reduce water consumption per capita.

The educational campaigns were successful due to the quality of the teachers who deliver the programme. The messages were consistent and moreover are delivered every year, which the company believes has more chance of success in changing behaviours than for example a three month campaign. A longer campaign with a positive and consistent message about the benefits of water efficiency, that does not involve 'preaching' have been proved more successful.

Company C

The success of the campaigns is measured by how many customers have taken up offers following a promotion. The company would organise events in a public place, for example a supermarket, then hand out products, counting the signatures as they are signed for.

The success in the education programmes would be ascertained by feedback forms from participants that would ask what the participants thought of the programme and whether or not they had changed their behaviours. This information is collected using a before-and-after questionnaire so that the savings can be shared with the participants. The feedback forms also ask whether people had taken the company's messages on board, whether they order water saving products, or if they are involved in a product trial. The company would then log the respondents and follow up with ways to save water.

In terms of the success of the campaigns, the company has achieved their regulatory targets for the previous four years. Thus everything they have done has impacted on achieving those targets. There have also been learning curves along the way where some things could have been conducted in a better way. For example this could be to classify customers' information in a more efficient way so that their needs could be more understood. Overall, Company C have achieved the savings they set out to do.

Another factor that contributes towards success is an increased awareness on how to save money. The water-saving packs are still being ordered and distributed. The education programme is also deemed very successful due to good feedback and repeated requests to visit schools.

There is room for improvement in that the company could have classified data and targeted water-saving packs more efficiently. The company is aware of the need to invest in data gathering exercises before an installation visit, with a focus on smaller areas in the future.

Company D

Initially when the company started the campaign they were not sure of its success. New literature was produced in addition to establishing different forms of communication including mass mail-outs inviting customers to participate. This has resulted in limited success during the first five year period. However the company has now changed their approach as they now understand that not all customers respond to communication in the same way. Thus the

company has tailored their communication methods to engage customers, which has been a more successful approach.

Company E

The metering programme has been one of the most successful due to its sheer size i.e. 33,000 home visits

What were the criteria of your evaluation for the effectiveness and efficacy of your campaigns?

Company A

The main area of effectiveness has been the uptake in reaching customers. There are independent communication teams which collate the data on how many people received the message, whether the target audience were engaged, and what percentage of the supply area received the message.

Actual reduction in water consumption during campaigns is difficult to monitor as most households do not have water meters. Thus it is difficult to evaluate the effectiveness of campaigns as the company would need to investigate if the results were due to the campaign, the media or another factor.

Overall the company has learned that it should increase the amount of effort and investment in engaging and communicating with customers, particularly through social media and where they have existing networks and external partnerships. Forging links with other organisations and the government would ensure the same message is delivered to consumers and could result in better value for money, rather than a scattering of smaller campaigns everywhere. It would also be more effective to collaborate with partners such as other water companies to deliver the campaigns and education programmes.

Company B

Company B's education programme was evaluated through targeting questionnaires to children before the campaign and then three months and finally twelve months after. Questions were asked such as 'Did you get the message and do you still turn the tap off?'. On the whole, the educational campaign was assessed by the number of participants, the questionnaires completed and what children could remember after the event. If this message is not clear to children, the teachers would tailor the message and change things in the campaign to make it more interesting to children.

To evaluate the effectiveness of campaigns with businesses, meter readings are undertaken and the company advised staff to install water saving devices such as water efficient shower heads which are effective in a large business such as a hotel. No specific messaging is targeted at businesses to encourage water conservation, it is aimed at saving money. The company would aim to reduce the business water use by 30% by conducting simple checks on leaking toilets and taps. Businesses were also given a flush bag to save a litre of water. The company feels that their educational campaign combined with practical advice will improve water efficiency measures.

Company C

Evaluation is dependent on different criteria which are tailored to the purpose of the campaign. It could also be measured in terms of the number of respondents to a campaign, or how many letters were sent and received by customers. For other campaigns such as advertising promotions through the company's sponsorship of the weather, the effectiveness would be measured by how many people responded either by phone or by visiting the website.

Company D

Due to the size of the campaign there was no basis of comparison for any type of evaluation to be conducted. However the company carried out small trials which involved visiting customers and installing products to see if they were 'accepted'. This formed the basis of further trials.

The company did not research the client base prior to any installation visits, so they did not have a prior knowledge of their needs. This resulted in a reactive approach in which the needs had to be established during the initial visit. As the customers' knowledge of water issues had not been assessed, it could mean that the products were not used properly.

Company E

The effectiveness of the campaign is not just limited to engagement, for Company E it is measured by changes in behaviours. This is reflected in Company E's five year business plan which details specific per capita consumption figures for each customer. The target is to reduce from 148 litres per person per day, to 133 litres. This will be supported by various initiatives. If the targets are not achieved, the company will be fined. The company also views financial incentives as a major way of influencing behaviour.

5- Improving campaigns

Company A

To improve campaigns, Company A would increase the emphasis on simple changes to daily routines to enable consumers to reduce their bills. Water is also seen as emotive, due to its relevance to hygiene and also how it can be enjoyed as personal luxury. A dialogue could be set up about what water means to different users, so they could be targeted accordingly. A link with energy and other utilities could also ensure a range of savings.

Company B: no information

Company C

There is room for improvement in that the company needs to classify its data more efficiently and target how water-packs are distributed. The company is aware of the need to invest in research before an installation visit, with a focus on smaller areas in the future.

Company D: no information, Company E: no information.

6-The influence of the Media and water education

Company A

The benefits of using mass media include its ability to reach a wider audience. Although this would suggest that working with the media is vital to campaigns, Company A prefers to communicate through full time educational programmes. This is because it represents an on-going campaign that should have a long-lasting impact on customers. However, education requires more investment in time and resources in order to get the best impact on water saving behavior. The main message of the campaign is to present the view that water is not an endless resource just because it rains, as per capita, quantities are not high (L192-194).

Company B: No information. Company C: No information. Company D: No information.
Company E: No information.

7- Impressions about the approaches used in the UK and whether or not they are appropriate for application in Saudi Arabia - Suggestions for water education in Saudi Arabia

Company B

There is a suggestion that the education programme could work elsewhere in the world. Fitting free water saving devices in Saudi Arabia could reduce from 40 litres to 10 litres of water per minute when showering. This would save money as well as water, which could be reinvested elsewhere such as subsidising the cost of bills. The data has already indicated that many members of the public would be keen to try these products if they were free, but customers would need to be informed why it is necessary to save water in Saudi Arabia and how desalination is neither environmentally nor economically sound in the long term; and how the water in aquifers will eventually run out.

Aquifers as a finite resource may provide a suitable narrative to begin to share information about conservation.

The broad messages in making simple behaviour changes such as turning off taps and showering for less time would be equally applicable to Saudi citizens. It is also important to understand the culture and religion in the country before work is undertaken.

The Company B interviewee advises the educational approach as being universally applicable; children may be readier to learn about conservation and the environment. It is anticipated that children would then influence their parents and families to not waste water.

Company A

No direct comparison is made with regard to water consumption in Saudi Arabia. Company A is aware that London and the South East are becoming more multi-cultural with differing populations consisting of various faith groups, communities, and religions. This needs to be borne in mind during water awareness campaigns and in communicating with other religions and faith groups in order to meet their needs for water. Company A has commissioned a study to work with different religions, faith groups and religious leaders within London to help design better messages for these community groups.

Through working in partnership with religious institutions such as mosques, there would be a great potential to save money, as consumers are open to the idea of reducing their costs when companies implement water efficiency measures. Each faith group, church, mosque and community can be supported as individuals or collectively as groups. Company A is conducting water efficiency trials in Wapping mosque (London) which is undergoing a retro-fit to re-use water and become water efficient. Therefore this could potentially be implemented in different communities across the world.

Regarding water awareness in Saudi Arabia, Mr Andrew suggests the need to be completely open and honest about water issues and to promote water education as an effective tool. This involves educating the Saudi general public about the water cycle from its origins, through to its supply.

More insight could be gained by showing the general public what a desalinisation plant looks like, how pipes are installed and maintained, how treatment plants are run and how waste water is treated. The public need to understand the costs of providing water per cubic meter every day, every year and how much it costs to deal with waste water. If the educational approach is used in a manner which the lay person can understand, it can be an effective way of raising

awareness and helping the Saudi public to better understand the process and the value of water.

Company A interviewee recommends making the technical details of the provision and treatment of water available to the general public, to aid their understanding. This could be demonstrated by flow diagrams, maps for each region of the country and links to the water process. This could be more engaging than providing quantities of written information to the public.

It was also emphasised that when transferring the water efficiency experience from the UK to Saudi Arabia, it would be essential to start at the baseline of communication and education. This will make the process easier and could attract funding. To successfully encourage water efficiency, it is important for households and businesses know how water conservation will benefit them and also to understand their role and the importance of making changes to their actions. This should be conveyed in honest and open communication through campaigns and full-time education.

Company C

The company does not specifically employ different practices for people of different nationalities as part of their water usage focus.

Company D

Company D interviewee possesses no knowledge of the water consumption within Saudi Arabia.

However she suggested that depending on the aims of the campaign, the water organisations need to decide how much money they are willing to spend on resources like large-scale television campaigns. However they can be very costly to administer, therefore a cost-benefit analysis is necessary. A decision then needs to be made as to whether that money is spent or whether the company may require further financing.

Company E: No comparison made for Saudi Arabia.

8- Religious influences – such as working with faith groups, or Religion and water awareness

Company B

As Britain is a multi-faith country, religion as a factor needs to be carefully considered when engaging customers. The company could visit religious establishments such as mosques to advise on water efficiency, but this requires a sensitive approach. The Company B interviewee suggested that targeting specific religious groups may not be an effective strategy in the UK.

Company A

Company A is working with faith groups such as churches, mosques and others who may not have been responsive to previous campaigns on saving water. By working with these groups, the company can design more effective campaigns that are more suitable and practical for their religious needs. In addition, Company A can benefit greatly from communicating with such a cohesive network through which to convey appropriate water and energy efficiency messages.

Company C

Regarding water awareness amongst religious customers, Company C worked with the group 'Faith for Change' in the Burnley area of Lancashire. This involved visiting mosques to conduct water efficiency measures and training for women who would then pass on the message to other women in the area. The messaging was different as it was targeted around the communities' religious beliefs and how it would fit in with their lifestyles. Local people helped each other to see the benefits of saving water in their daily activities.

When working with different nationalities across the UK, campaigns may need to be conducted according to specific geographical areas, with respect to different languages and traditions including how they may use water differently. Churches were not targeted as part of the campaign.

Company D: no information

Company E

Communicating with customers in a language they understand is important. An opportunity could also exist to engage customers through their religious practice, but this would need to be clearly defined. The UK still retains a Christian culture where the earth is considered an important part of religious culture, therefore environmental campaigns have been conducted in partnership with churches.

Water is an economic commodity, and it is vital to save money and promote water as a finite resource which is a different perspective on the situation. Ultimately, the correct channels for communication need to be facilitated.

9- Views on Water awareness and behaviours in the UK from the company perspective

Company A: their views are expressed in the summary 8 above.

Company B: Generally, the public view water as a plentiful commodity as it frequently rains in the UK, leading them to assume water is more readily available and does not need to be conserved. This can make it difficult design water efficiency messages, as rainfall is plentiful for almost six months in the UK from October to March.

The Company B interviewee also believes that the cost of water is relatively cheap with the average yearly bill at approximately £400. Thus, if an individual earns between £25,000-30,000 a year, this bill is easily affordable. Customers are more concerned about gas and electricity bills, where they might cost up to £1400 a year for a typical home.

Therefore Company B looks at combining both energy and water saving messages so that customers can calculate how much energy they could potentially save and also how they can change their behaviours. The general belief is that water is available because of its heavy rainfall, but people do not take into account the UK's dense population.

The public is also unaware of the costs involved in treating waste water as they have little awareness of the process to chemically clean water, which requires storage and infrastructure. The level of awareness about conserving water is consequently very low.

Water saving messages are further complicated by the changing weather patterns of the UK. It is vitally important to tell consumers that water is an important and limited resource and explain how the creation of reservoirs is not sustainable because of the lack of availability of land. It has been found that customers actually respond to the idea that saving water will also save disruption by digging pipe lines on the roads, the message then is that saving water also saves disruption. If every consumer changed their behaviour they would save money and their water bills would reduce, but as the population is increasing, water will be needed from another source.

Consequently the company would prefer to targeting resources to raising awareness as it is more economical and sustainable than providing water saving devices, but as there is no preconception in Saudi Arabia around their climate, the message should be easier to spread.

Regarding the cost of providing water in Britain, it is economically effective cheap and customers are charged proportionately for their water use. However they do not all appreciate the environmental benefits reducing this usage, which is another important message for consumers.

Company C: their suggestions are summarised in section 8 above.

Company D

They raise important points about the costs of providing water, as the company believes that people do not value water in the way that they should because UK because energy prices rise so frequently. Customers are acutely aware of the need to save energy but are less concerned about water because it is considered cheaper than energy.

Further to this, the Company D interviewee gives examples of how people would remember to switch off lights but would leave a tap running, or hose down a family dog. This makes it extremely important to and extremely challenging to change the mind-sets of the UK population by demonstrating that water is a valuable commodity which should not be wasted.

Company D interviewee also mentions a small minority of people have the attitude that paying for water means they can use it how they like. Water companies face a continuous challenge in getting people to stop and think about their water behaviour.

Company E

Water awareness approaches differ around the UK as there are different patterns of rainfall. The public's perception of metering is consequently different. In Scotland for example, the perception is that metering is not an issue. However in the South of England there is a dense population residing in small areas, compounded with changing rainfall patterns and climate change overall. All these factors play a role in the fluctuations between droughts and floods. Therefore managing water under such circumstances is important and in areas where there are these climate issues, there is a general awareness that energy and water are a legitimate concern in the UK.

10- Future plans from UK companies for raising water awareness in the UK

Company A: None discussed. Company B: None discussed

Company C: In the future, Company C will focus on geographical areas, specific types of customers and types of property in order to make the water-efficiency messages more efficient as opposed to sending blanket messages out to all customers. Therefore they will consider focusing on promoting products that would aim to help individual customers.

Company D

For future reference, the most important aspect is knowing how to engage customers in meaningful ways. Previously the company had relatively little contact with customers, apart from sending a yearly bill. However following recent initiatives, the company is conducting out-reach programmes, including face to face visits. These opportunities must be utilised by the company to collect any other customer data that may be useful in the future in addition to discussing conservation messages.

Company E

In the next five years Company E will change the way they operate with third party providers during home visits. In the current five year period they are being paid per visit, but in the next period they will also be paid for what they have actually achieved in terms of reducing metered consumption in each household. Thus, the incentive is increased for the home visit to be a productive intervention.

In the company's plan there is also a discussion about desalination in Southampton and ensuring it is efficient process.

5.2: Summary of the data

1-Number of campaigns carried out:

UK water companies, number of campaigns carried out

Water company	Number of campaigns carried out:
Company A	Over 20 campaigns
Company B	Data not available
Company C	Data not available
Company D	no definitive number, although water efficiency programmes' exist
Company E	seven different initiatives

2-The aim of campaigns:

Each water company has a different campaign focus.

3-Evaluating campaigns and the Level of participation

In the education programme, this is in a questionnaire format for teachers and pupils to complete every 12 months.

1. Company A: They aimed to target several thousand customers in a district metered area (DMA). Water use is monitored on one meter on the network that supplies 1,000 domestic homes.
2. Company B: Campaigns are targeted with the assistance of Acorn data
3. Company C: Specific Geographical areas are targeted in this large region.
4. Company D: 87,500 customers were invited to participate in water efficiency campaigns
5. Company E: 33,000 customer home visits were made in the last five years, and 166,000 water saving products were fitted.

4-The effectiveness of campaigns in general

Company A: In the drought of 2005-2006, a large campaign called 'Beat the Drought' reduced overall water consumption by 7- 14%. Dialogue about drought will continue.

Company B: Company B believes the educational campaigns they conduct are successful because they help in achieving long-term water efficiency gains. The company aims to achieve long-term water efficiency over a period of ten years to reduce water consumption per capita.

Company C: The company has achieved their regulatory targets for the previous four years. Water-saving packs have been distributed and the education programme has had good feedback.

Company D: The company has changed their approach and tailored their communication methods to different customers.

Company E: The metering programme has been very successful due to 33,000 home visits conducted.

5- Improving campaigns

It was found several factors could enhance water saving campaigns as follows:

Emphasise how simple changes to daily routines can make a difference;

Link campaigns with energy use to ensure savings for both.

Deliver campaign packs to specific types of property or people;

Conduct research before an installation visit.

6-The influence of the Media and water education

Mass media can reach a wider audience. Educational programmes however are worth the extra time and effort to produce long term effects.

7- Impressions about are the approaches used in the UK whether they are appropriate or inappropriate for application in Saudi Arabia?

The UK managers suggested the following approaches:

To be completely open and honest about water issues

To educate the general public about the water cycle, which can be demonstrated via pictures and videos of how water flows to households and businesses;

To involve the general public by inviting them to see a desalinisation plant and understand how pipes are installed and maintained, how public stations and treatment plants are run and how waste water is treated.

To inform the public about the costs of providing water per cubic metre every day, every year and how waste water is dealt with.

To use educational tools which the lay person can understand,

To discuss how water is provided and treated, demonstrated by flow diagrams, maps for each region of the country and links to the water process.

Decide how much money should be spent on large-scale campaigns

8- Religious influences – such as working with faith groups or Religion and water awareness

As Britain is a multi-faith country, some success has been achieved by working in partnership with different religious and community groups.

9- Views on water awareness and people's behaviours from the company perspective

They vary according to region. The South is densely populated and suffers changes in rainfall patterns leading to fluctuations between droughts and floods. In general however people see water as plentiful because the UK has frequent rainfall. In addition water is cheaper than other utilities.

10- Future plans from UK companies for raising water awareness in the UK

Company C: They will focus on specific areas and customers instead of sending out blanket messages.

Company D: they conclude that the most important aspect is knowing their customer base in order to engage in meaningful ways.

Company E: In the next five years they will pay their third party provider for positive results in water savings. The possibility of desalination in Southampton will be discussed.

Chapter 6: Towards a Proposed Paradigm for positive public participation

6.1 Paradigms towards integrated urban water management from the literature review

A brief survey of existing paradigms of water use will now follow. They will be assessed as an introduction to the proposed paradigm for integrated urban water management that will be presented in the next chapter. Examples from the literature review are relevant at this stage because they present examples of paradigms that can serve as an introduction to the proposed paradigm.

In the literature review in Chapter 2 of this thesis, several paradigms were discussed along with their relevance to IUWM. Initially, these paradigms did not put human action at the centre. The Cross Sectoral Dialogue through IWRM from the GWP in 2000 (Figure 9 above) was innovative in its attention to a range of stakeholders, but it was organised purely in terms of provision, with 'people' as one of a number of consumers. Although the diagram is about dialogue, it seems to be more of a one-way conversation.

Likewise, Figure 10 the Three Pillars and the Principle of IWRM (2004) cite policy and legislation as its enabling environment, with information as a management instrument. There is no dialogue here, despite the term 'enabling' suggesting that some actions will be taken in partnership. IWRM is handed down or imposed at this stage.

The process was not specifically urban until the importance of the urban water cycle began to be understood (Figure 12) which began to put human actions at the centre of the process. Bahri (2011) went a stage further, placing human action at the centre of the diagram and also showing how water, drainage, sanitation and waste were co-dependent in a renewable cycle. (Figure 13) An earlier model, Cowie and Borrett (2005) (Figure 16) was titled the 'Key Element of a Conceptual Model of IUWM system and IUWM hierarchy'. What is significant about the hierarchy, it that managers and members of the public take part in a two way dialogue.

This was a proposed paradigm that saw the value of communication. The diagram did not display any specific actions that may be used in a IUWM system however, as it was purely conceptual.

Another significant move towards a practicable paradigm shift discussed earlier was the SWITCH Transition Manual (Jefferies and Duffy, 2011). It was the culmination of a research project aimed at achieving more sustainable integrated urban water management thirty to fifty years from now. In order to face these challenges, SWITCH aimed to facilitate a paradigm shift in urban water management by converting previously reactive and ad-hoc actions into a coherent and consolidated approach (Figure 22). Jefferies and Duffy stated: 'The overall approach is termed Integrated Urban Water Management (IUWM), which addresses the whole urban watercycle and delivers all-round benefits for society, the environment and economies' (Jefferies and Duffy, 2011). The nature of this project was a long term transition and it underlines the complexities of a fully integrated system. As the system of IUWM is only partially practiced in a few larger cities, it could be said to be at the beginning of the transition process, but it is a process that must begin with the dialogue that this research has provided a basis for.

6.2 Water Conservation

The following are discussions of mainly Global initiatives, which could offer advice for the implementation of integrated urban water management. They are included because they model strategies which could be adapted for IUWM. Water conservation has much in common with IUWM in principle. It is also a multi-stakeholder and participatory approach involving water users, service providers, governmental agencies and non-governmental organisations, leading to economic savings and an improvement in the distribution of available water supplies. The research data from the Saudi public indicated that people had some awareness of the importance of conservation and this indicates that participation in conservation would be a good place to begin raising awareness. 'Water Conservation Awareness' is a comprehensive guide (UNESCAP, 2006) that could be adapted as a plan for the implementation of IUWM. Significantly, it values dialogue between administrators and the general public, so that perspectives and attitudes of water users can play a part in decision making processes.

Water conservation refers to actions taken to use water efficiently and is formed of two parts: water resources conservation, efficient management, storage, allocation and transfer of raw water'; and water supply conservation: 'distribution with minimal losses and consumption without wastage.' (UNESCAP, 2006). Water conservation awareness (WCA) is an understanding of the need to use water efficiently at all stages of its cycle, in order to promote changes in attitudes and behaviour with regard to water management and use. At present only a few countries practice WCA, hence the attention from both UNESCO and ESCAP.

The UNESCAP Guide (2006) explains the importance of WCA in integrated water resources management before focusing on a framework for a strategy. Eleven steps are recommended to prepare a detailed strategy for promoting WCA, as follows. These steps are taken from the UNESCAP Guide (2006) and their context is a framework for Asian and Pacific countries. They are familiar in the sense that recommendations in the data have expressed elements of this, such as increasing legislation, educating children inside and outside the classroom and targeting women to share knowledge, but in this case, they are all encapsulated into a single initiative, which, to reiterate, could be adapted to IUWM.

Step 1 - Set up a managing committee (or board) to manage WCA promotion. Individuals with skills in social marketing, public relations, education and communications are required in addition to water professionals.

Step 2 - Identify stakeholders. The effectiveness of promoting WCA will be improved by taking account of the views of those with direct interests in both preparation and implementation of the strategy, and its success or failure.

Step 3 - Analyse policy issues, issues regarding political commitment, institutional strengths and weaknesses, reasons for water shortages and the affordability of the true cost of water.

Step 4 - Review local factors. The WCA strategy recommended in this Guide should be adapted to local political, socio-economic, cultural, legal, environmental and geographic factors.

Step 5 - Identify target groups. WCA should initially be promoted to main target groups such as politicians, water professionals, community leaders, teachers, the media and non-governmental organizations who will then assist in promoting it to the public.

Step 6 - Identify partners and sponsors. These may include: government agencies, water supply utilities, NGOs, similar campaign organisers, professional associations, multilateral agencies and private companies keen to promote a socially-responsible image.

Step 7 - Agree on aims and key messages. The committee should prepare aims and key messages for promoting WCA as a first step in designing specific campaigns, which will usually have two stages: raising awareness and triggering behavioural change.

Step 8 - Identify WCA promotion activities. Detailed activities can be planned using a logical planning framework: what are the issues to be raised with each audience, which messages are important to deliver, and what are the most appropriate ways to deliver them?

Step 9 - Set communication targets and time tables. Five years should be allowed for a WCA promotion programme to achieve a good level of awareness, within which several short-term campaigns for behavioural change can be scheduled.

Step 10 - Set budget and secure funding. A budget and financing plan should be prepared on economic cost-benefit grounds and discussed with government, partners and potential sponsors to secure funding. Annual campaigning usually costs a few per cent of a water utility's budget.

Step 11 - Set up project teams. When funding has been committed, the committee should recruit an overall project manager and establish project teams to implement specific WCA activities.

Government at every level should also be involved and community initiatives are equally important. UNESCAP believe that community involvement builds local perspectives into the decision making process and gives a community ownership over the process.

Education and information programmes are central to promoting WCA. UNESCAP focuses on three categories of people - water providers, water users, and children and students but the process would be adaptable to other water users. Water authorities are advised to raise awareness about conservation and advise ways to reduce bills through rationalisation and water saving devices. Education in schools prepares for what UNESCAP describe as a water conservation culture. Such a cultural change would require conservation awareness to be

embedded throughout the curricula and beyond, into everyday life. Teachers would also require training to improve their own subject knowledge and working in partnership with water organisations and other stakeholders would be essential.

In addition to education, communication in all forms is essential to promoting a culture of conservation. However this needs to be on many different levels, for example media support would need to be exploited through different channels. As we have seen before, women should be targeted as role models who can bring good practice into the home.

Legislation should also play its part, but they need to be fully understood by all users in all social groups.

Monitoring and evaluating effectiveness

Both the delivery of the programme and its results need to be evaluated and follow up activities such as surveys should be carried out and by implication, the methods should be constantly under review.

Recommendations

UNESCAP recommends that all nations adopt an integrated approach to Water Conservation Awareness. They also require partnerships with government and water utilities (they also recommend privatisation) to promote WCA. Activities to involve the public should be planned by a range of organisations, social, educational and artistic. The strategies should be constantly reviewed and monitored

This UNESCAP guide has been paraphrased in detail in order to highlight how elements of the framework could be transferred to a IUWM context. In addition it provides a wealth of advice in organising a comprehensive programme that puts communication at its heart. In this way, the framework is close to the proposed paradigm of this research, but could not be successfully applied without a comprehensive data review about its client base (e.g. the KSA) such as this research provides.

6.3 Water Recycling

As recalled earlier, Barhi in 2011 (figure 13) showed how water, drainage, sanitation and waste were co-dependent in a renewable cycle. The research data showed that although members of the public had some knowledge of conservation and felt that it was important, recycling had met with an almost entirely negative response. Waste water and recycled water however could play as significant a role in the urban water cycle as fresh water, following Bahri's model.

In 2011, *The Environment Writer* website published 'Turning Grey to Green: The State of Water Recycling'. It was published in response to what the writer perceived as unhelpful regulations in many US states governing the use of recycled water, despite the increasing scarcity and cost of water. The background of the paper was therefore a lack of understanding about recycling water, which has some similarity with the Saudi situation. The paper describes two types of water that could be recycled: greywater and waste water (also known as blackwater).

Greywater is usually household water from bathrooms and kitchens. The writer states that greywater accounts for about 60%-80% of the outflow produced in homes, but because it does not include human waste, it requires a different treatment process. It is a much cheaper process, as the water does not contain pathogens and has 90% less nitrogen. At the moment, the writer feels that it is underused, because most greywater is used for irrigating plants and gardens. As discussed in the questionnaires to the Saudi public, greywater could be used for flushing toilets. This was not a popular idea, as the awareness levels about greywater are low. Also the technology required is expensive, but the writer of 'Turning Grey to Green' describes in the paper how the same process could be used to provide drinking water. It would require some relatively low cost changes to household plumbing to separate the water, as shown in Figure 76. As the Saudi public were not happy about greywater being used to flush toilets however, it can be inferred that they would not yet be ready to accept greywater being recycled as drinking water. Information such as that summarised in 'Turning Grey to Green' however would be useful in a process of awareness raising.

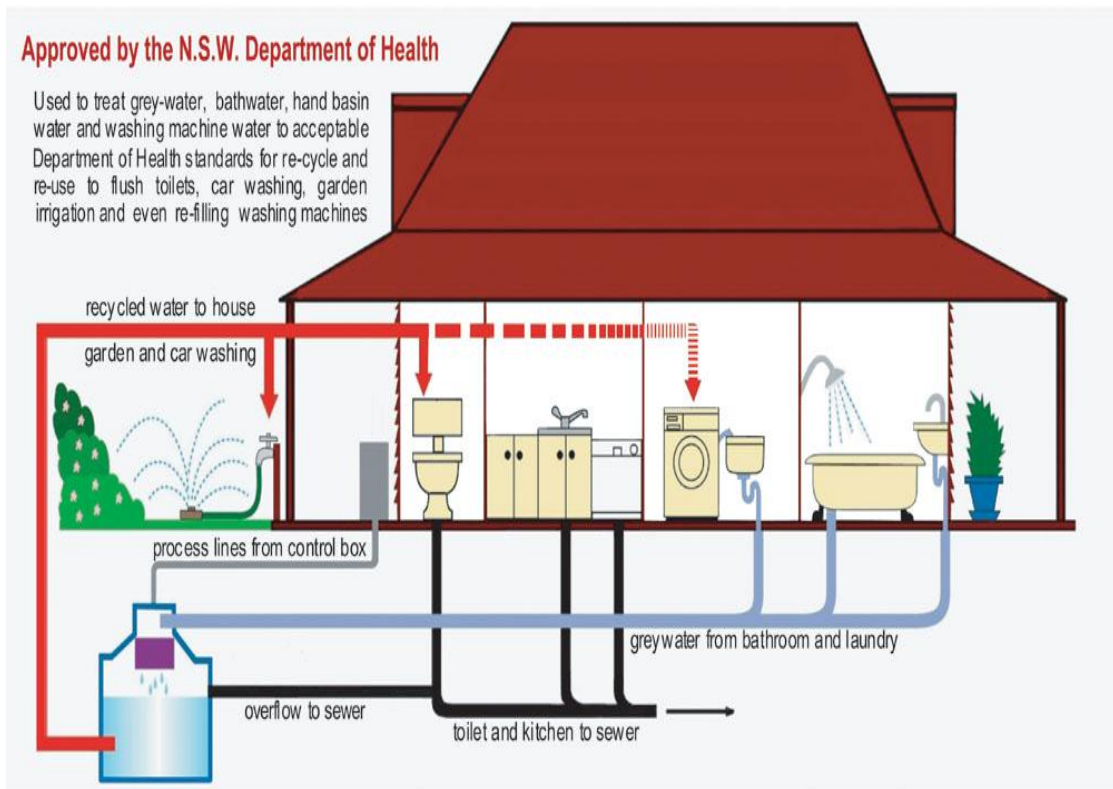


Figure 76: Household greywater recycling diagram

The list below is quoted from the paper and could be modified to apply to the Saudi situation. It lists the advantages of using greywater.

1. Reduces the amount of potable, fresh water used by households.
2. Reduces the flow of wastewater entering sewer or septic systems.
3. Minimizes the amount of harmful chemicals used by homeowners.
4. Supports plant growth without using expensive potable water.
5. Helps recharge groundwater when applied outdoors.
6. Raises public awareness of natural water cycles.
7. Saves money on water bills.' (*The Environment Writers*, 2011)

The author points out challenges however. The recycling process uses a lot of chemicals at present which may cause contamination and also the cost of the plumbing is much higher for larger buildings. Further research would be needed on the safe disposal of the chemicals.

Wastewater, also known as blackwater, is sewage or toilet waste. It needs to be recycled on a large scale in centralised plants, according to the paper, because of the dangers of contamination. In the US it is used for these methods:

1. Turf irrigation
2. Industrial
3. Agricultural irrigation
4. Drinking water

(*The Environment Writers*, 2011)

To recycle blackwater for drinking water is a long process including filtration, sterilisation and dilution. The writer explains that it takes up to three months before the water is drinkable. The time span is one challenge to this process, but the greatest, as it would be in the KSA, is that people are deterred by the very notion of using treated sewage in their homes. If greywater was a challenging prospect to the public, blackwater may be a step too far at this stage. However, there is some possibility to raise awareness so that this resource is not wasted, as it could be used for industry or for the irrigation of plants that are not destined to be eaten. This paper also demonstrates how public agreement is essential before introducing changes, but that a careful process of awareness raising could engage people with processes that they were heretofore reluctant to tolerate. This level of communication again, is central to the proposed paradigm of this research.

6.4 Consumer Education

In 2012 The Global Water Partnership presented *Characteristics of Raising Public Awareness* in response to the need for public support and understanding that can be encouraged by educating consumers. This approach has been suggested many times by the respondents in the research data, usually through leafleting and other media use. This paper suggests another method which could be transferred to the Saudi situation: product labelling. The writers see increased education about awareness as being empowering, in that consumers would be able

to make informed choices and also develop some sense of ownership through these choices.

This quotation is significant:

Ideally, public awareness is not a one-way communication, but an interaction of many active stakeholders, who influence each other and provide social control by mutually reinforcing, agreed sets of values. (The Global Water Partnership, 2012).

Careful targeting of consumer groups is also cited, as is the idea of using a logo. They suggest a water drop to give a recognisable identity to the campaign, which would also assist consumers to make informed choices. A process of awareness-raising could empower consumers to make water-friendly product choices. These products could then be made immediately identifiable by the use of a logo and any other essential information as long as it was presented clearly and easy to understand. This is a paradigm that could be transferrable to the Saudi situation and encourage the two way dialogue that is essential for the implementation of IUWM.

6.5 Environmental Awareness

The UNESCAP Guide (2006) emphasised how it was important to take a multi-agency approach to creating a culture of water conservation. This culture could include recycling as discussed in the section above and also a wider sense of responsibility to the environment. The data has shown how this can be encouraged from a religious aspect in the Saudi situation; and other partners could include the Presidency of Meteorology (PME) and the Environment and the Saudi Environmental Society (SENS). The purpose of an environmental culture would allow consumers to make choices based on their perception of their place in the wider world and begin to understand water as a finite, global resource. The research data has indicated that there is a perception in Saudi society that the public are self-centred (this was strongly asserted by respondents to the students' questionnaires). As suggested, this notion of being 'self-centred' can be addressed by awareness-raising and the promotion of a culture of the environment could assist the public to see their water usage as part of a global concern.

The Pachamama Alliance is a global network of promoting a culture of the environment and uses the rainforest as a symbol, because it is an instantly recognisable image that brings to

mind environmental concerns. The alliance aims to describe environmental awareness as ‘an ideology that evokes the necessity and responsibility of humans to respect, protect, and preserve the natural world from its anthropogenic (human) afflictions.’ (<http://www.pachamama.org/about/mission>). As in the In their mission statement they go on to stress the importance of empowering and engaging people, through which process, the public should be able to make informed environmental decisions.

In the chapters following, these initiatives and those from the literature review will be brought together to form the new paradigm proposed by this research, that will aim to prove the possibility of a solution to the implementation of integrated urban water management, that has communication at its heart. Firstly, the research sub questions will be summarised, prior to the conclusions to the main research question.

Chapter 7: Discussion

7.1 Answers to the research sub-questions

This chapter will address and discuss answers to the research sub-questions through referring to relevant conclusions from the data analysis. This will also summarise the contribution to knowledge made by this research. To reiterate, here are the research sub questions.

1. What is the current level of public awareness of water issues?
2. How much public engagement is likely?
3. How and to what extent can public engagement be stimulated to enhance integrated urban water management in KSA?
4. How and to what extent can public engagement be harnessed to enhance integrated urban water management in KSA?

7.1.1 What is the current level of public awareness of water issues?

The data gives us an interesting view of this. Teachers viewed the question from their own subject knowledge and from their observations of their pupils' behaviours. On the whole, they perceived a current lack of awareness that included members of the teaching staff. This is reflected in the lack of consistency towards initiatives like World Water Day.

Water Managers felt that the level of public awareness was currently at a low level, largely due to a lack of organisation and a failure of institutions to work together and plan campaigns for raising awareness.

Most water engineers viewed public awareness as weak and expressed the opinion that current campaigns had a temporary effect due to a lack of co-ordination between policy makers.

Environmental managers perceived a split between major cities and smaller towns, expressing the opinion that there would be a greater level of awareness in cities.

Academics mainly agreed with managers, in that they see levels of public awareness as weak and that a lack of co-ordination in the water sector is contributing to this through a lack of co-ordination. There were some academics however who had seen evidence of good awareness.

So far, the data has shown that significant groups within Saudi Society perceive public awareness of water issues to be at a low level, but the data from the public sample shows a different picture. Although the majority of men from Riyadh, Jeddah and Albaha stated that they felt there was a low level of awareness and no evidence of a culture of responsibility towards issues of conservation and pollution, their own opinions showed that they were themselves aware of water issues. Agricultural over-use and the lack of renewable sources are causes for concern. Geographical issues are relevant, i.e.as the infrastructure of supply, particularly when there are problems with supply outside the major cities, or reliance on deliveries by water truck, in which there are problems with water supply to the hamlets that are located on the mountains areas or in the desert. This contradicts the opinions of the environmental managers, who felt that awareness would be weaker outside the major cities.

Women in the public sample also showed a greater level of awareness. Geographical issues were also relevant, with women who lived in areas that were not linked to the supply network (such as Tehama regions) expressing concerns about levels of supply and issues of pollution. They were also aware of the importance of conserving rainwater. However, nearly half the public sample did not show a good level of water awareness.

However, although there is probably some awareness about some of water issues, there is also a lack of knowledge about important issues such as the cost of water and how much water is actually needed for everyday tasks. In addition to the survey of Saudi citizens, data was collected from non-national Arab men and women. The results of both of the public surveys were broadly in agreement as the majority of both Saudi and foreign citizens did not have a clear idea of the average daily domestic consumption of water. There was agreement again in people's perception of the real cost of water, with a significant majority unaware that the government contributes 99% of the cost of water provision. In addition, nearly half of those sampled believed themselves to be badly informed. Both groups agreed that an increase in

general awareness of water issues would be the most efficient way to make a difference to usage.

With a general agreement about the need to raise awareness alongside some contradictory evidence in the current level of awareness, this brings us to the next research sub-question.

7.1.2 How much public engagement is likely?

Teachers felt that there were barriers to increasing public participation because of the perceived behaviours of some social groups. There were concerns about a significant minority who were understood to have no sense of responsibility towards the over use of water because they are perceived to see water as a cheap commodity. The teachers believed that there were cultural problems around the use of water and that low tariffs were a barrier to public engagement. On the other hand, most of the teachers agreed that education provided an excellent opportunity to encourage good behaviours in children from an early age, and that they could pass these onto other members of the family. Teachers agreed that schools and mosques could work together in partnership to increase public engagement.

Water managers agreed that increased public engagement was possible, but only through a significant improvement in the organisation of the water sector. It was also believed that mosques and schools could work together to significantly improve awareness.

A significant number of water engineers believed that this perceived lack of organisation in the water sector was a barrier to increasing public engagement. However, they also agreed that partnerships with schools and mosques could embed good practices, beginning at an early level in education.

Academics raised an important topic, that of creating a culture of awareness. To achieve this would require a necessary improvement in public engagement. To this end, schools and mosques could work together with the media.

The students from Saudi Arabia expressed concerns similar to the teachers in that they felt that some social groups, particularly the wealthier demography, would be resistant to increasing their engagement because they were accustomed to using resources as much as they wanted. They also agreed that a cultural change was necessary,

With respect to the public surveys, the Saudi men saw barriers to engagement through perceived attitudes to harvesting rainfall and reusing water. The evidence from the data showed that the majority of both Saudi and non-Saudi citizens would not be happy to reuse water, or to harvest rainwater. These techniques were seen as belonging to the past. In addition, the vast majority of respondents had not made contact with any water awareness campaigns. Also the data from the Saudi men in particular indicated that they believed that institutions were in control of water issues, which may prevent them from seeing themselves as stakeholders in future, or else that their actions would not make a significant difference. This indicates that there would be barriers to the creation of the culture of awareness suggested by some of the academics. Women however, seemed to be more optimistic overall.

Saudi women in particular believed that education had an important part to play in increasing public engagement. Like the teachers, they saw the opportunity for children to learn good practices and share their knowledge with the rest of their family. There is potential therefore for a significant increase in public engagement.

Conclusions can be drawn in that partnerships between schools and mosques are seen as vital for increasing public engagement. However a lack of organisation in the water sector is seen as a barrier to effective campaigning, which is supported by the fact that few members of the public had any involvement with water campaigns. In addition to this, the data showed that traditional techniques of conservation are no longer practices and indeed are thought to be inappropriate to the 21st century. Although there is potential for an increase in awareness, the data suggests that there are currently barriers to achieving a high level of public participation.

The question of how to improve this through stimulating public interest will be addressed in the next question.

7.1.3 How and to what extent can public engagement be stimulated to enhance integrated urban water management in KSA?

Many participants made several general comments about the role of mosques, schools and awareness campaigns as a means of increasing public engagement, but in order to stimulate public engagement successfully, there needs to be more specific information about the nature of these campaigns unpicked from the data. As we saw in the section above, campaigns can be ignored by the public if they fail to stimulate interest.

Teachers suggest that engagement could be stimulated through promoting religious aspects of water conservation, which could be supported by the mosques. Texts that promoted the responsible use of water could be read and discussed in a religious context. Teachers also felt that steps could be taken to reward or sanction water behaviours, which would stimulate interest and perhaps a sense of competition amongst pupils. This could be further encouraged by a more organised approach to water days that could include projects and competitions. So that this engagement could be stimulated to the fullest extent however, these initiatives would need to play an important role in the school curriculum and not just be evident on the occasional water day.

In support of some of these ideas, water managers also felt that there should be improvements made to the school curriculum, which at the moment did not seem to have a strong enough approach to water issues. The managers felt that this could be improved through building partnerships with schools in order to embed messages about conservation and water use. In the light of the lack of knowledge expressed by the participants in the public surveys, especially around the real costs of water, this would be essential to ensure that engagement could be stimulated to a level that would enable behaviours to become embedded in everyday life.

In addition to encouraging the responsible use of water through education, the water managers also felt that sanctions could play a part in stimulating engagement. The threat of higher tariffs

may encourage the engagement of high volume users, such as the wealthier social groups identified by the teachers and students.

The water engineers also supported the idea of sanctions in order to remove complacency about water and to stimulate public engagement and participation. They also supported positive action such as working with mosques in order to align responsible water use with good religious practices and were broadly in agreement with water managers and teachers in believing that engaging school children would promote good behaviours in the home. Again, however the message would have to be repeated and embedded in order to be successful.

Academics and students were strongly in support of the use of media, including social media to stimulate public engagement, but some academics felt that the public would be more engaged by home visits than leaflets or video campaigning.

This could be supported by the public data, which revealed that only one person in the men's cohort had ever picked up a leaflet. There needs to be an integration of different approaches in order to ensure that campaigns stimulate a high level of public engagement. Women tended to agree with the academics in that they believed that a more personal and educative approach would be most successful in stimulating engagement. They also believed that early years education would be the best place to start. Some of the men suggested a different approach to stimulate engagement in that education about tradition may stimulate interest in conserving and harvesting rainwater. This could also be incorporated into religious life through focussing on appropriate texts, as suggested by the teachers.

In addition to the traditional and religious values of conservation, the public surveys also contained data about the potential of water saving devices in the home. Although there was little widespread use of these devices at present a significant number of both the Saudi and non-national members of the public expressed an interest in using these devices if they were

provided for free. A campaign of home visits to install such devices could be successful in maximising public engagement.

So far, the data has presented evidence current awareness levels, which were not as low as some cohorts had suggested. It has also indicated the potential for stimulating engagement through an integrated range of campaigns, initiatives and educational programmes. This notion of integration is vital in the response to the final research sub-questions and it also brings the discussion back to integrated urban water management and how public perceptions need to be at the forefront of planning.

7.1.4 How and to what extent can public engagement be harnessed stimulated to enhance integrated urban water management in KSA?

The discussion of the data has moved from engagement, to participation and will now focus on action. Harnessing this potential level of engagement should lead to meaningful actions in the responsible use of water.

Earlier in the discussion, teachers made reference to the fact that they felt that attitudes to water presented a cultural issue. They felt that there were certain aspects of Saudi culture that had a negative effect on water issues, such as a tendency to view water as a cheap and plentiful resource. On the other hand there is the potential, through education and the mosques to reverse this trend and view water as a finite resource that should be conserved. The key to producing action in terms of improved water behaviours is partnerships and integration. For example, a home/school integration could see children passing on good behaviours to other members of their families.

It was also interesting to note that in the water managers' data, some managers felt that there was a need to take public views into account, but on the other hand, a significant number of

managers believed that this would be unhelpful. This is further evidence that the level of public interest and awareness can be underestimated at an institutional level. It is significant therefore that some managers are beginning to see that public voices will be necessary in future planning. What all this data suggests is that there is a need for integrated urban water management, but that it must be integrated on different levels that will including public participation. Likewise, some water engineers also saw the potential that every citizen could contribute to water management. This could only be achieved if public awareness and engagement could be harnessed to produce meaningful action.

Academics had raised the possibility of a whole culture of awareness raising, which could result in a change in water behaviours that could in turn play a part in supporting integrated urban water management. It seems from the data that the positive modelling of good behaviours through mosques, schools and interactive campaigns may result in a longer lasting harnessing of engagement than sanctions or the raising of tariffs, because these behaviours could become part of the culture of everyday life. A very powerful point made by some of the Saudi women was that schools, mosques and campaigns could work together to create an environment in which people could see themselves as part of the solution, as well as part of the problem. This could be evidence for the positive cultural change envisioned by some of the academics and indicate the potential for the role of public participation within integrated urban water management.

Following this review of the research sub-questions, the next section of the discussion will look at possible actions that could facilitate the implementation of integrated urban water management and maximise public participation. These proposals are related to the discussion of the data and are suggestions that may resolve some of the issues raised both through the data and other areas of this research.

Chapter 8: Conclusions

This research presents an overview of interpretative analysis of water awareness and positive public participation in integrated urban water management (IUWM) in Saudi Arabia. The research targeted different stakeholders to investigate the current practices and visions, in order to determine the extent to which IUWM could be enhanced by positive stakeholder participation and public awareness. The research presents an overview of the answers of the following queries: is it necessary to have more public awareness/positive public participation to enhance IUWM processes? Is there a history of past involvement? Are there active groups who can be engaged? To what extent must enriching the public's water knowledge play a part in IUWM?

The philosophy of the research is interpretative through an inductive approach. There was a combination of both quantitative and qualitative analysis based on the nature of the different aspects of the survey. The majority of survey questions were analysed through the method of coding, thematic and interpretative analysis. A survey methodology was used to investigate water awareness and public participation in IUWM in Saudi Arabia.

Data collection was through in-person administering of hardcopy questionnaires in Riyadh, Jeddah and Albaha, collecting responses from a wide range of stakeholder groups. A feature of the methodology for this project, in particular, is the identification of opportunities for transferring learning from UK experiences to the Saudi situation. This was from the face-to-face interviews with five water companies in the UK. Overall, this study focuses on the social-economic (political, economic and cultural) rather than the physical (environmental, ecological, hydrological) dimensions of IUWM.

From the findings of this research, there is a need to develop stakeholders' knowledge by increasing current understanding relating to IUWM in the institutional, educational,

environmental, industrial and social fields/sectors. In order to achieve that the process will occur optimally through building a strong foundation for collaboration within the water sector to encourage Saudi society to participate in the implementation of IUWM. This should be partly based on positive public participation resulting from high public awareness of water issues. Therefore, the research proposes strategies for stimulating and harnessing public engagement in water issues.

Findings show the extent of the possible enhancement of IUWM by the positive stakeholder participation and raising public awareness. Therefore, the reader can understand the importance of the educational programmes in order to educate the general public about the water issues. Then, the reader will realise the effectiveness of water awareness campaigns in general, as well as how to improve the water awareness campaigns and understanding the influence of the Media, where the successful water campaign will be based on communication, educational and institutional arrangements and these arrangements will in turn produce positive actions with respect to water use.

Moreover, findings clarified the public water awareness level of water issues and the potential role from different perspectives in raising levels of awareness and engagement in water management. Additionally, the views of water managers from the UK gave the potential of UK water awareness campaigns for application in the Saudi situation.

8.1 The proposed paradigm for public engagement in Integrated Urban Water Management

From the literature review in Chapter 2, it was observed that paradigms of integrated urban water management put human actions at the centre, beginning with the urban water cycle (Figure 12) and including Bahri's paradigm (Figure 13), where it was noted that despite this centrality, communication with the public was a one-way process from management to the public. At the outset, it was clear that communication should be a full dialogue process, so that all stakeholders had a voice in the process which would enable a sense of ownership for all participants. Cowie and Borrell had developed a paradigm of dialogue between managers and customers (Figures 16 and 17), but it was a theoretical model and no specific actions were proposed.

This need for a paradigm that took into account a productive dialogue between the public and other stakeholders became clear in the new primary source material produced by this research. Through the analysis of the questionnaires and the application of the research sub questions, it was clear that an improved raising of awareness was vitally important for the provision of IUWM. It is so important, because increased knowledge is required to promote public engagement so that engagement can be harnessed to produce actions, such as changes in behaviours.

However it also became clear that the different stakeholders did not know each other sufficiently well. The data from the UK managers had emphasised that it is important to know your client base, but there were some misconceptions with regard to the public that the data brought out, for example they expressed more interest in water conservation than other stakeholders had perceived.

In order for dialogue to become productive and eventually lead to these necessary changes in behaviour with respect to water, consumers should be responsible and make informed choices. The UNESCAP Guide (2006) for Water Conservation Awareness suggested a participatory

process that could make consumers part of the decision making process itself. There has not yet been suggested a process for integrated urban water management that could enable water consumers to reach such a level of participation, but it will be proposed that the new paradigm for this research can solve this problem.

The data from the analysis of the questionnaires and interviews is fundamental to this paradigm because without it, it will be impossible to know the customer/stakholder needs sufficiently well to target new information and engage them. This evaluation presents the first stage of the paradigm. The second stage shows how effective participation produces meaningful actions and an engagement that produces a continual dialogue between stakeholders, which will be termed a dynamic loop, because as the public become more aware, they can participate fully in the process and play a part in decision making processes. After the analysis; the effective paradigm for enhancing the implementation of IUWM has been proposed, as illustrated in the Figure 77 below.

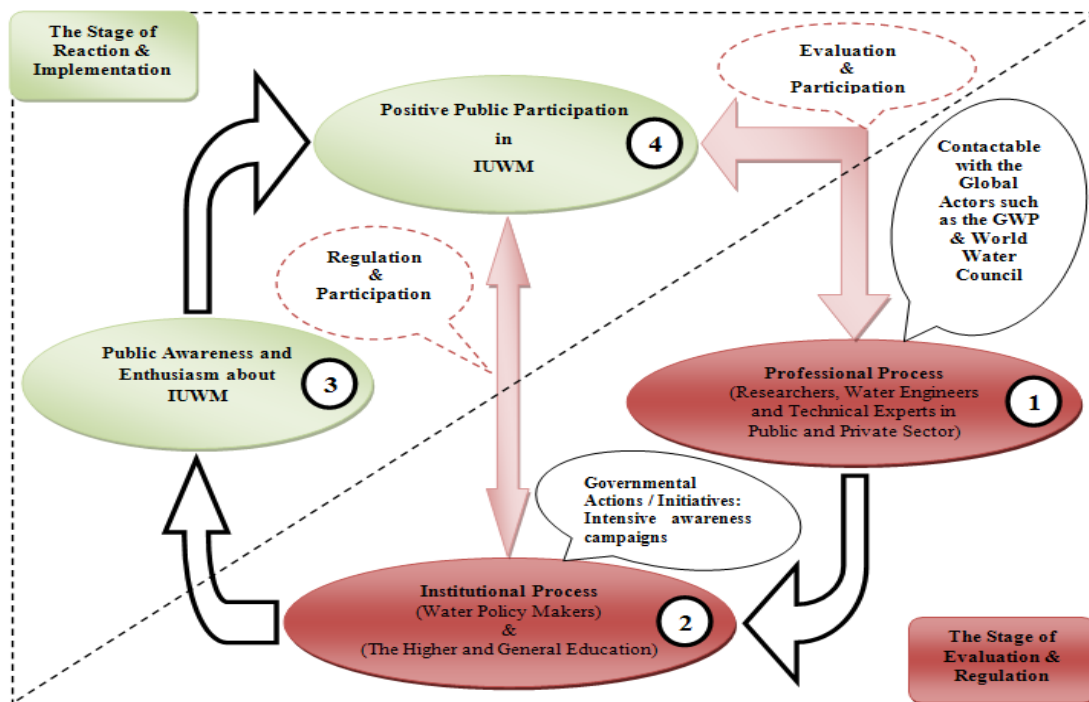


Figure 77: The proposed loop mechanism of dynamic implementation of enhancing the positive public participation in IUWM

8.2 Specific conclusions in relation to the research question

To what extent can Integrated Urban Water Management in Saudi Arabia be enhanced by positive stakeholder/public participation and public awareness?

This was the major research question for this thesis and from a full investigation of the evidence, we can conclude that it is fundamental to the proposed paradigm and fundamental to the practice of integrated urban water management. Conclusions to the other chapters will now be presented in support of this.

This research took the form of an investigation into public engagement in integrated urban water management in Saudi Arabia. It aimed to evaluate the potential improvements that could be achieved by both public engagement and positive public participation with water awareness in Integrated Urban Water Management (IUWM) in Saudi Arabia.

The research has shown strong indications that the Kingdom needs to move significantly towards this integrated approach to water management and that public engagement and positive public participation should be seen as an important component. This is evident from both the literature (secondary data) and the primary data which were originally collected and investigated through a field trip in Saudi Arabia and a survey in the United Kingdom.

The project analysed several surveys featuring a range of stakeholders within the KSA, including the general public, water professionals and managers, policy makers, water managers, environmental managers, technical practitioners and engineers, industrial managers, lecturers, students and researchers. The project then investigated how to transfer experiences from the UK into the Saudi situation through an investigation of how the UK water companies succeed in increasing both the awareness of water usage and the participation in efficiency programs. The research concluded that the UK water companies present a useful model that will encourage the Saudi public to see themselves as stakeholders in addition to being consumers.

The analysis of this data was the foundation of the proposed paradigm and the basis for the successful investigation of the main research question. Positive public participation and public awareness, with the public acknowledged as full stakeholders, is fundamental to the practice of integrated urban water management. IUWM itself is essential because it is the only paradigm that can take into account human actions at its centre. Again we can refer back to the proposed paradigm, figure 4 above, in which the second stage in particular shows how carefully targeted plans and initiatives lead towards new ideas and suggestions of which the public, now a stakeholder, will have ownership. This co-operation between stakeholders should create a dynamic loop of continual suggestions and solutions, leading to the public support of the comprehensive implementation of integrated urban water management.

Before such a paradigm could be put into operation, however, the research concluded that to bring these different groups with all their different perspectives together as active stakeholders, there needs to be a significant increase in the current levels of understanding in the institutional, educational, environmental and industrial fields in addition to the public field. This understanding also includes a much better knowledge of the consumer base than the managers have at present, so that information can be targeted effectively, and eventually produce positive actions.

Transferring the UK experience of raising water awareness to the Saudi situation

Beginning with the social and public realm, the research established that the five UK water companies achieved their aims through making public awareness the cornerstone of their campaigns. This was supported by both a long term approach and the use of integrated planning with partnerships, such as Company B's educational programme. Underpinning this was a targeting of different consumers' needs and a full understanding of the client base, as in Company C improved use of data. The companies also achieved their aims through reviewing their practice, which would require dialogue with consumers and produce that dynamic loop of information exchange, required by the paradigm.

From the investigation of these five UK water companies, we can conclude that there are opportunities for transferring experiences from the UK water companies into the Saudi situation in terms of how to design, plan and evaluate water campaigns, if they are made part of a strategy for IUWM. In addition, the Saudi water sector can learn from the UK successes in raising water awareness through the following strategies.

1-Plan the number of campaigns required

They should be planned for the long term, according to the information they need to convey to consumers.

2- Consider what could impact on the aim of campaigns

A range of factors needs to be considered. These include the unique geography of the area, water stress, governmental and industry regulations, the location and type of consumer households and finally the role of education and other partners in promoting water efficiency.

3-Evaluate campaigns and the level of participation

Levels of participation could be addressed by asking for feedback from the participants throughout the campaign. A twelve month campaign supported by a questionnaire can measure the success of the campaign and evaluate its impact. Vulnerable customers should also be engaged such as those on low incomes. In addition, larger families would typically require more assistance to reduce their bills which would be comparatively high.

4- Review campaigns

Water needs to be linked with other forms of energy in order to promote a culture of reducing household bills and water usage. However water is an emotive issue due to its necessary role in hygiene, so in order to improve campaigns there needs to be a focus on how positive actions can be included in peoples' daily routines. This could be achieved through targeting consumers with appropriate information.

However, although these strategies can in theory be transferred to the Saudi situation, it has been found that there are significant barriers with respect to the level of public participation required by these UK models. It has suggested (as in the students' data) that a cultural change is required so that the Saudi public see water conservation as their individual responsibility in addition to that of the mosques, the schools and the state. This notion of a culture change around water was also highlighted by the UNESCAT Guide (2006) which placed a detailed process of dialogue and public engagement at the forefront of its campaign,

Issues of awareness in the public and social sphere

With some slight gender differences in the results, most of the Saudis thought the most effective public campaigns should be run by mosques, schools, water service providers or other government organisations. The role of the mosques has the advantage of encouraging changes in behaviours through religious belief.

The use of water saving devices had met with a mixed response. There was however some encouragement in that a proportion of those sampled were prepared to use water saving devices if they were provided free. This trend was evidence that the public are prepared to make changes to their behaviours, but detailed information about the environmental benefits of the devices would need to be provided in order to encourage the necessary sense of participation.

However, the data also underlined the fact that a cultural change with respect to water issues is a long term process, because there are many preconceptions that will need to be addressed, including changing the attitude of the public to the recycling of greywater and the traditions of collecting and harvesting water. Harvesting water was no longer seen as part of people's everyday lives, which represents a barrier to promoting those cultural changes. To reiterate, cultural changes require a lengthy process of dialogue and exchange of information, which to some extent the UK water companies achieved in persuading people that despite the climate, water is still a limited resource that needs to be conserved. With respect to the KSA, however.

It must also be remembered that the data also showed a positive tendency for the general public to be interested in water issues.

We can conclude from these results that on the whole, the current situation shows that there has to be a considerable amount of work done to prepare for the implementation of IUWM. There needs to be a focus on raising awareness through dialogue in order to promote a necessary sense of responsibility amongst the general public, so that the process of IUWM can begin. As the data showed, although there is some interest in water issues, most people are not sufficiently well informed about basic issues such as the amount of water needed to carry out daily tasks. This will not yet enable positive behaviour changes.

Key areas for effective partnerships: Education, mosques, industry, management and the environment

This section includes a brief summary of the discussion chapter above. In addition to the public consultation detailed above, the research carried out a study of the perceptions of teachers, academics, industrialists, environmentalists, engineers and water managers. The following key areas were identified as potential partners in a multi-agency campaign to address water issues. Firstly (as in Company B's educational programme), schools must play a key role, as we have seen in the teachers' data, they were however, aware of differing levels of knowledge about water issues amongst their pupils and it was felt that partnerships with water authorities, including field visits, would be crucial in implementing an effective education programme. It was also suggested that schools could provide an effective hub where all the different workers in a school, including cleaning staff, could gain subject knowledge and pass this on to their own families. A sample of Saudi students in the UK also identified primary education, beginning from nursery, as a key area.

Religion, because of its impact on everyday life was also identified as a key area by teachers, students and also as we have seen, by the general public. For teachers, a partnership with

mosques could establish changes in behaviours and perceptions by encouraging the responsible use of water on religious grounds.

The media is also seen to have a key role to play, according to teachers and students. Television, films and the internet could all contribute to raise awareness of water issues and (particularly for the Saudi students) warn people of the consequences of maintaining their current levels of usage.

Teachers and students agree however, that raising awareness may not be enough to change the behaviours of some social groups, in particular wealthy individuals who use excessive amounts of water for cleaning their properties and filling their swimming pools. It was felt that the high level of government subsidy for water provision made it difficult for some people to appreciate the scarcity and value of the resource. However, this was indicative of a tendency for stakeholders to have a limited understanding of consumers as a group, as their own data contradicted this view to an extent. Again, full knowledge of the needs and opinions of the general public is required before effective campaigning can be put in place.

More evidence that the stakeholders needed to work together more was provided by the survey of academics, who concluded that at present there was no co-ordinated principle of integrated management for water issues, leading to problems throughout the whole infrastructure of provision.

The need for central planning is also evident in the lack of communication between the different ministries that would be responsible for the co-ordination of partnerships. Media and Education would be unable to work together effectively without the integrated support of the ministries of Education and Culture. Within the water sector itself, water managers have highlighted disagreements between the SWCC and the MOWE. Water policies cannot be centrally planned with so many conflicting agencies.

As a result of this lack of centralised integrated planning, the research is in agreement with the position of Environmental managers in the MOA and PME who state that there are no effective standards and criteria applied accurately to measure the success of the current exploitation of resources in a country subject to water scarcity. The responsibility falls to the Ministry of Water and Electricity. However, it is felt that their directives are inconsistent, as is their commitment to global directives.

Furthermore, desalination projects (which could play a major part in long term planning for water provision due to the current stress on aquifers) lack effectiveness because the SWCC is not subject to the Ministry of Water and Electricity. This is despite the fact that desalination and purification have been included in a long term plan for the provision of drinking water until 2050. There is also over-dependence in the industry on oil based technology. Although the KSA is perceived as an oil-rich economy, the costs mean that desalination is not economically viable. The potential for using solar energy however has not yet been fully investigated. This lack of co-ordination is reflected in the failure of municipalities to work together with the MOWE to implement a programme of repairs and maintenance. Finally, it must be concluded that the current piecemeal organisation must be replaced by a centralised, independent ministry which will work with a range of partners to facilitate an effective integrated response to water issues.

To summarise, the research arrived at the following conclusions. Having considered the analysis of the data including in this strategy the best use of ideas from the UK companies, the SWITCH transition manual (2011) and the UNESCAT Guide (2006), among others, the following steps could be taken. This could begin the process of awareness raising, participation and action that should enable the dynamic of the proposed paradigm.

1. Public participation is essential, but to enable this, a cultural change is required with respect to water conservation. People need to see conservation as their responsibility rather than that of the government. Although people are prepared to use water saving devices if they are provided for free, the traditions of conservation are seen as no longer relevant to everyday life.

Communication is necessary at every level, but is impossible without a comprehensive overview of the client group of water users, such as this research accomplished.

2. Infrastructure is lacking. An integrated response is required in the form of an independent ministry for water acting in partnership with mosques, education, industry and government to end any conflict of interest.

3. At present there are no standards or criteria to measure water usage or to provide recommendations for domestic users, industry or irrigation in agriculture.

4. Repairs and maintenance of the facilities for water provision need to be carried out quickly and efficiently to reduce waste.

5. There is a lack of efficiency within current desalination projects that impacts on its potential to play a part in any long term strategy for water provision.

In order that these issues can be addressed, the research proposes that the successful implementation of IUWM must begin with comprehensive data gathering, in order to facilitate the level of communication required by the paradigm. In support of this, the study recommends the following points for further research.

8.3 Discussion of future actions

1- Build an effective infrastructure to implement long term planning

A single independent organisation such as a Ministry for Water (unlike the MOWE which has a shared responsibility for Electricity) must be established through the IUWM to manage the water sector and accomplish the necessary integrated planning, management, distribution, supply and recycling of water. This organisation should be independent of any other interest groups

A database must be established in order to gather and organise accurate and relevant information about consumers so that their needs can be targeted and that they can feel that they have ownership over water supply issues. This database should be effectively managed and constantly updated using the newest information systems and technologies available.

Although a national IUWM strategy is required for the KSA as a whole, it must be remembered that different localities will have different needs. The UK has over twenty water suppliers including the five that were studied in this research. These provide an effective infrastructure within the UK that can adapt central planning to regional needs and build their own campaigns. The KSA has an existing infrastructure that could be adapted using the UK model as a template. Currently water is administrated regionally through thirteen directorates in thirteen provinces. As there is a branch in every major city, these existing directorates could take on responsibility for integrated urban water management and administrate water provision, sewage and recycling. At present the NWC and the SWCC are working as separate organisations however and the KSA privatisation plan is not complete. Again this points out the need for a single ministry of water to oversee the administration of water policy by the thirteen directorates.

This ministry could also work with global partners in international water projects and programmes. At present any collaboration is very limited.

2- Promote the view of the public as stakeholder through working with partnerships: mosques, schools and media

The samples of public opinion and teachers were broadly in agreement that mosques and schools would be the most effective partners in promoting the awareness of water issues. Mosques have the benefit of communicating daily to their communities and any water company would benefit greatly in working with them to convey their messages of water efficiency. More importantly mosques can provide the religious context that can change behaviours in people's everyday lives and show them how saving water can fit in with everyday life and be compatible with religious practice. Such a partnership could re-educate the Saudi public in how much water is really needed for hygiene and cleanliness and address the general reluctance to use water saving devices.

It has been noted how Company B has a successful partnership with schools. Partnerships in the KSA could work at a local and also a centralised level. Schools can work with regional directorates and a central Ministry for Water could promote awareness of World Water Day, Arab Water Day and similar campaigns. Children can pass on knowledge of water awareness and the water cycle to their parents. Most importantly they could provide a model of good practice.

Water managers had also suggested that there should be a focus on educating women through the Ministry of Social Affairs, but ideally this should be the responsibility of a Ministry for Water. Water managers also stated that any code of practice needs to be shared as soon as possible with migrant workers in the KSA to ensure consistency of water usage.

The media can play an important part in promoting and improving campaigns. Media can effectively target short term campaigns of water awareness through educational programmes, but is expensive and at present there is no data available about the longer lasting effects of media campaigns on consumers, this should be addressed perhaps using samples and focus

groups before media can be successfully planned into a campaign. Again, this shows the need for the proposed partnerships to work together to increase public participation at a local level in addition to any centrally planned approach.

3- Remove anxieties about the use of grey water, promote recycling and investigate the cost of fitting water saving devices into homes

In the public consultation, some interest was expressed in using water saving devices if they were provided free. A feasibility study needs to be set up to investigate the cost of providing households with these devices. This could contribute to making huge savings in water usage. Such a study could be centrally planned and again administered at a local level.

Water consumption can also be reduced through recycling and re-using, but as stated earlier in the research, there is a strong opposition to these practices due to cultural attitudes to waste water. A long term educational programme is required to address these anxieties, possibly administered through schools and mosques. The religious element in the partnership could have the advantage in conveying how the practice of saving and recycling water is consistent with belief.

4 – Develop more efficient means of irrigation and encourage farmers to grow crops that require less water. Investigate costs of compensation

Effective urban water management also requires the co-operation of agriculture where irrigation can be improved to decrease water usage and waste. Water consumption has been increasing in rural areas and agricultural companies need to be targeted. This could be administered at a regional level, again as part of a national policy, but farmers would need to know how they would benefit from projects to grow crops that require less water. A compensation scheme could be cost that would assist farmers with making these wholesale changes to their practice

5 – Carry out a feasibility study of metering households and businesses and research the possibility of increasing the water tariff

As we have seen, the Saudi public are unaware of the current level of government subsidy for water provision. Also, there is an assumption that there are sectors of the public who may be unwilling to reduce consumption, such as wealthier individuals (though this, and other such assumptions, requires more research). Some water managers from the SWCC have expressed a need for encouraging good practice through raising the water tariff. There was significant opposition to this proposal from the general public, however and a proposal would require preliminary research and a detailed campaign to raise awareness and encourage support.

A large scale metering programme may be possible along the lines of Company E. This would require an extensive feasibility study, perhaps in one of the thirteen directorates which could then be rolled out in stages to the rest of the KSA.

6 – Investigate changes to the law that could enforce guidelines with respect to water consumption and necessary repairs to the infrastructure

This recommendation was suggested by environmental managers because at present there is insufficient incentive for managers to apply current laws and regulations. This has resulted in a failure to carry out repairs to the infrastructure of water provision, leading to excessive wastage. These laws should be managed by an independent board, ideally the proposed Ministry for Water. A legal limit to water consumption could be specified for home and commercial use to ensure that guidelines were followed.

7 – In partnership with engineers and industry, set out a timeline for the updating of sewage and drainage networks

A feasibility study could be carried out in which each directorate would be responsible for updating their own infrastructure, subject to central planning, in order to ensure consistency of

provision throughout the KSA. This is essential to promote participation from all sectors of the public. From these initial studies, a timeline could be established for the completion of the works. The individual directorates could be managed centrally by the Ministry for Water.

8 – Develop the use of efficient solar energy in desalination projects

At present desalination projects are inefficient and over reliant on oil. The Saudi government intends to invest more than fifty billion dollars in upgrading the desalination plants over the next fifteen years so funding is currently available to develop more efficient sources of energy. Academia and industry could work together to develop solar panels that will be suitable for this growing industry. In addition, an improved infrastructure of pipes will be required to ensure that desalinated water is distributed fairly around the KSA.

As stated at the beginning of this section, these are practical steps that would need to be carried out to ensure that there was improved infrastructure, reliability of water provision and structures in place for co-ordinating awareness-raising programmes. They are however underpinned by the philosophy of participation and communication that is at the heart of the proposed paradigm of this research. The discussion will now move onto the conclusion of the research.

8.4 Further points for research

The recommendations of this study offer the following points for further research.

National action plan: National Comprehensive Water Action Plan (NCWAP)

The International Monetary Fund is currently preparing a study to develop an integrated strategy to run all water resources in the KSA. The first stage of planning is complete and work is now underway on the second phase. Public participation and awareness is included in this national action plan. An investigative study of this plan and its possibility for success should be undertaken, bearing in mind the recommendations of this research.

Saline Water Conversion Corporation (SWCC)

The SWCC has worked with several committees to assess the needs for drinking water until 2050. An integrated strategic plan including desalination and purification plants has been put in place. There is the opportunity for further analytical and scientific research in improving desalination through developing effective solar power and through the development of an infrastructure to transport the water around the KSA.

Set up a centralised data base using the newest information technology

In order to set up a comprehensive database of public awareness and needs around water, suitable IT systems need to be investigated and tested through academic and industrial projects.

Improving irrigation and managing crops

A civil engineering study could investigate the feasibility of applying efficient irrigation methods to agriculture in the KSA. Scientific studies could be carried out to identify and manage suitable crops for the regions.

Updating and completing the infrastructure for water provision and sewage management.

There are further opportunities for research in civil engineering projects that could investigate efficient methods of updating and replacing the current infrastructures.

Improve and develop domestic water saving devices.

The testing and development of new prototypes could provide opportunities for scientific projects and studies.

Investigate the most effective use of media in campaigns.

A media studies project could thoroughly investigate how best to target media campaigns in order to retain knowledge and enthusiasm for water issues.

Research project reflection

As demonstrated in this paper, the project can be termed as a success as it has been able to provide answers to the research questions. The main research question, "To what extent Integrated Urban Water Management in Saudi Arabia can be enhanced by positive stakeholders/public participation and public awareness?" has been answered after carrying out both quantitative and qualitative analysis of surveys. To successfully address the main research question, a number of sub questions were formulated. These questions included, "What is the current level of public awareness of water issues?" "How much public engagement is likely?" "How and to what extent can public engagement be stimulated to enhance integrated urban water management in KSA?" and "How and to what extent can public engagement be harnessed to enhance integrated urban water management in KSA?". By breaking down the main research question, the accuracy of the results and hence the reliability of the research was improved. However, the research project can be improved by making use of a centralised data base using the newest information technology.

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Appendix

1. Questions for Policy Makers; water managers/politicians

- Is there scope for more integrated urban water management (IUWM) in KSA? What forms do you feel this should take?
- How would you describe public awareness, attitudes and behaviour in relation to water issues in KSA? How can this improved?
- How successful do you feel public awareness campaigns on water issues have been in KSA? Why? (Please give specific examples if possible)
- To what extent do you feel attempts at raising public awareness of water issues are worthwhile? Why?
- How do you feel raising public awareness of water issues can be most effectively achieved?
- Do you think there should be managing committee that involves water planners, social marketers and educators, water professionals and environmental engineers to manage water conservation awareness promotion? How should this committee be formed and how should it operate?
- Should water awareness campaigns be targeted at schools? How should this be done? Why? Why not?
- Do you have good cooperation with Ministry of Culture and Information for raising awareness of water issues? If yes, please describe it.
- How can water authorities improve communication between participants/consumers and private sector (private-public water companies)?
- Do you have cooperation with private water companies in decision making relating to water awareness? If yes, please describe it.
- How closely do you work with the Global actors such as the Global Water Partnership, World Water Council, International Water Association, International Water Resources Association, International Desalination Association, Water Quality Association and others?

- What kind of cooperation do you have with the international water projects and programs Such as The International Hydrological Program (IHP), World Water Assessment Program (WWAP) and World Water Development Report (WWDR)?
- Please only answer this question if you are working in the Ministry of water and electricity:
The international monetary fund is preparing a study to develop an integrated strategy to run all water resources in the K. S. A. The planning work has finished its first stage and they are going to complete work in the second one. Is public awareness and participation included in the action plan? What is the success of the action plan until now?

1. Questions for Environmental Managers:

- What does integrated urban water management (IUWM) mean to you?
- To what extent do you feel it is practised in KSA?
- What barriers and challenges might there be to IUWM in the near future of KSA? And how could they be overcome?
- How would you describe public awareness, attitudes and behaviours in relation to water issues in KSA? How can this improved?
- To what extent do you participate in water conservation awareness promotion and particularly in behavioural changes towards environmentally-friendly water use? How are these carried out? With which organisations? What is the frequency/ how often?
- What role can your organization play in integrated urban water management in terms of changing behaviors towards urban water irrigation systems whether from domestic users or industrial users?
- How do we raise the community knowledge about water pollution issue?
- Do you think there should be managing committee that involves water planners, water professionals, social marketers and educators, environmental engineers and teachers to manage water conservation awareness promotion? How should this committee be formed and how should it operate?

2. Questions for Technical Practitioners and water engineers/experts

- What does integrated urban water management (IUWM) mean to you?
- To what extent do you feel it is practised in KSA?

- What barriers and challenges might there be to IUWM in the near future of KSA? And how could they be overcome?
- How would you describe public attitudes, attitudes and behaviours to water in KSA?
- How do you feel raising public awareness of water issues can be most effectively achieved?
- Do you feel that water policy makers take account of the views of technical specialists like yourself in relation to IUWM?
- Do you feel that water managers/engineers in private companies face difficulties in influencing decision making by policy makers in the Ministry of water and electricity? Why? What do you suggest?
- Do you think there should be managing committee that involves water planners, social marketers and educators, water professionals and environmental engineers to manage water conservation awareness promotion? How should this committee be formed and how should it operate?

3. Questions for Industrial managers

- How would you describe your company's awareness, attitudes and behaviour in relation to water issues?
- What role do you feel your company can play in rising public awareness of water issues?
- To what extent do you feel attempts to raise public awareness of water issues are worthwhile?
- To what extent do you feel your awareness, attitudes and behaviour in relation to water issues in KSA can be enhanced by campaigns?
- What does integrated urban water management (IUWM) mean to you?
- To what extent do you feel it is practised in KSA?
- What barriers and challenges might be to IUWM in the near future of KSA? And how could they be overcome?

4. Questions for Lecturers/academics

- What do you consider to be the main water issues in KSA?

- To what extent do you feel IUWM is practised in KSA?
- Is there scope for more IUWM in KSA? What forms do you feel this should take?
- What barriers and challenges might be to IUWM in the near future of KSA? And how could they be overcome?
- How would you describe public awareness, attitudes and behaviours in relation to water in KSA? How can this improved?
- Do you think Saudi community is apathetic to water issues? If yes, how can the community be more proactive to the real situation of water scarcity in KSA?
- Is there a need to increase the public's participation in decision making in water sector? If yes how?
- In what areas could increased public awareness of water issues lead to benefits?
- What are the communication tools (that water planners can use for the social marketing) which can be adapted from commercial marketing for the eco-friendly water saving products/devices?
- From where would come the most effective public awareness campaign on water issues? (Tick as many as you like)

Mosques (Masjed)	
Schools	
Water services providers	
Other governmental organisations	

5. Questionnaires for Teachers in general education

- How would you describe your pupils' awareness of water issues in KSA?
- What role do you feel education can play in raising public awareness of water issues in KSA?
- To what extent does the current curriculum raise awareness of water issues? (if appropriate give examples)

- To what extent do you feel it is appropriate for schools to play a role in raising awareness of water issues? Why?
- Are there any aspects of culture in KSA that make this easy or difficult?
- How much enthusiasm do you have for this yourself? Why? If not, why not?
- How can raising awareness of water issues best be achieved in schools? What would need to change to achieve this?
- From where would come the most effective public awareness campaign on water issues? (Tick as many as you like)

Mosques (Masjed)	
Schools	
Water services providers	
Other governmental organisations	

- The

World Water Day (WWD) is an annual event celebrated on March 22; did you interact with this international event one week before the day (22 March) in your school? What is your suggestion if this happens again?

6. Questionnaires for The public

- What problems do feel KSA faces in terms of water issues?
- How well-informed do consider yourself to be in terms of water issues in KSA?

Very well informed	
Fairly well informed	
Fairly badly informed	
Very badly informed	

- What do you think is the average total daily domestic consumption of water per person (in liters) in KSA?

50	
150	
300	
550	

- What percentage of the real cost of providing water is paid by consumers? (The government pays the rest.)

1 %	
10 %	
25 %	
50 %	

- Please indicate which of the following ideas you believe to be the most efficient technique to save water (choose as many as you like):

Increasing the price	
Metering and charging more for exceeding the normal average consumption per person	
increasing general awareness	
More use of water saving devices	

- Have you had contact with any public awareness campaign relating to water? If yes, please describe the campaign, and how effective you felt it was.

- To what extent do you feel your awareness, attitudes and behaviour in relation to water issues in KSA can be enhanced by campaigns?
- From where would come the most effective public awareness campaign on water issues? (Tick as many as you like)

Mosques (Masjed)	
Schools	
Water services providers	
Other governmental organisations	

- Please indicate how prepared you are to use each of the following water saving techniques in your home.

	I would never use	I already use it	I would use if it was provided free
Water saving Faucet/tap aerator			
Energy efficient/saving Showerheads (low flow shower head)			
Water Saving toilet Displacement Bag			
Leak Detecting Dye Tablets or Toilet Tank Leak Detection Tablets			
	I would never use	I already use it	I will use it and recommend it to other people
Low flush toilet or Low-flow rinser toilet			
Water efficient/saving dishwasher			
Horizontal-axis/front loading washing machine			
Grey Water Recycling (Recycling water used for washing to flush toilets)			
Rain Water Harvesting			

7. Participant Information Sheet

1. Information about the project/Purpose of the project
This is a survey to determine the extent to which integrated urban water management could be enhanced by positive stakeholders' participation and public awareness in the kingdom of Saudi Arabia. We are specifically seeking feedback from selected stakeholders to help us analyse the social and institutional impacts on current water management in KSA and find out what the realistic possibilities and challenges are.
2. Why have I been chosen?
We want to gather the views of a range of stakeholders.
3. Do I have to take part?
No, participation is entirely voluntary. Your input will be very welcome though.
4. What do I have to do?
Participate in answering the surveys
5. What are the risks associated with this project?
None
6. What are the benefits of taking part?
As a participant you will be helping us to get a better understanding of the effectiveness of our project work.
7. Data protection & confidentiality
The data from the survey will be held without keeping your name, and any quotation will be given anonymously.
8. What will happen with the results of the study?
The data collected will be analysed and written up in the form of a final report. The results may also be presented at academic conferences and/or written up for publication in academic journals. We assume that by agreeing to take part in the interview/surveys you are giving your consent for us to use your answers (completely anonymously) in the study.
9. Who has reviewed this study?
The lead researcher: Professor John Davies
10. Who should I contact with queries about this research?
*The researcher or the supervisor (details below).
Researcher: Eng. Abdullah Alsaluli Email: alsalula@coventry.ac.uk or a.alsaluli@gmail.com
Lead researcher/supervisor: Professor John Davies,
Dept. of Civil Engineering, Architecture and Building, Coventry University, UK
Email: J.W.Davies@coventry.ac.uk*

8. Informed Consent Form

This is a survey to determine the extent to which integrated urban water management could be enhanced by positive stakeholders' participation and public awareness in the kingdom of Saudi Arabia. We are specifically seeking feedback from selected stakeholders to help us analyse the social and institutional impacts on current water management in KSA and find out what the realistic possibilities and challenges are.

I confirm that I have read and understood the participant information sheet for the above study and have had the opportunity to ask questions.

I understand that my participation is voluntary and that I am free to withdraw at any time without giving a reason.

I understand that I also have the right to change my mind about participating in the study until the end of December 2015.

I agree for a written record to be made and for anonymised quotes to be used as part of the research project.

Name of participant:

Signature of participant:

Date:

Witnessed by (researcher):

Name of Researcher: Engineer Abdullah Alsaluli

Signature of researcher:

Date:

9. An overview of campaigns to target raising awareness

1: Severn Trent Water

A: Climate Change campaign and Climate Week:

This campaign is presented in an online format on Severn Trent's website. This was also a bus campaign running in the Severn Trent region. The aim of the campaign was demonstrate to the public the steps they are taking to help tackle climate change and to promote awareness of the strong links between climate change and water. This was part of a week-long campaign which was launched in the Midlands as part of Climate Week at the award-winning low-carbon headquarters in Coventry. Climate Week aims to encourage individuals and organisations to take positive action on climate change. It is a week of activities which showcases practical solutions from every sector of society with events run by schools, businesses, charities, councils and local communities.

Severn Trent is also reminding customers how they can help contribute to tackling climate change by using water more efficiently. For example, reducing the amount of water wasted, particularly hot water, has massive potential to reduce carbon emissions and help cope with climate change. The pressures of climate changes are likely to lead to significant pressure on water resources in the future, making it even more important that waste is reduced.

The aim of the campaign was to enable members of the public to become more efficient in their water use. The number of individuals it has influenced however is not known. It is possible that the climate week initiative resulted in water users increasing their understanding and knowledge of water efficiency and that this may have influenced their behaviour. It was considered a successful campaign as it has improved the understanding of water resources and water efficiency.

To achieve this, the campaign targets a range of audiences with many events happening during the week including people running conferences, workshops, lessons, open days, exhibitions, performances etc. It is also sponsored by external organisations, enabling a wider marketing strategy. In addition, it is successful in its collaborative work with other water companies including Anglian Water, Scottish Water, Severn Trent Water, Thames Water and Wessex Water. The water companies together run similar activities throughout the UK to reach out to their customers and enable them to understand why it is important to save water. There were however, no evaluation tools such as surveys, water diaries or interviews conducted due to the nature of the marketing campaigns and its competition format.

This multi-agency approach, in collaboration with other organisations nationwide, presents an example of the kind of comprehensive programme of awareness raising that was highlighted in the data from the water managers and engineers. However, in order to transfer this experience, communications between different organisations within the KSA would need to be improved.

Severn Trent Water (2012) 'Climate Week' is available at: <<http://www.stwater.co.uk/severn-trent-launches-climate-week-in-the-midlands>>

B: Save Water, Save Energy, Save Money campaign:

This campaign was part of Energy Saving Week which aimed to give three simple messages to customers. The campaign promoted three things that could be done at home to help cut energy bills and save water. These included spending less time in the shower, filling up the kettle with only as much water as is needed and filling up the washing machine and dishwasher instead of running half-loads. The campaign has an online format with an image of children brushing their teeth to support the message of saving water by turning the tap off whilst brushing teeth, by implication it could also aim to encourage children to brush their teeth in daily life.

There were no evaluation tools used in this campaign, however, which aimed to change people's thinking and behaviour towards their individual water use. An accompanying survey or questionnaire would have been useful to provide quantitative data particularly if such a campaign could be used as a model for similar campaigns in the KSA.

Severn Trent Water (2013) 'Save Water, Save Energy, Save Money' is available at:
<<http://www.stwater.co.uk/media/news-releases/savewater-saveenergy-savemoney>>

C: 'Bag it, Bin it' – video

This is a video campaign by Severn Trent Water which aims to raise awareness of pipe blockages due to fats and oils being poured into sinks. It features two small children (Landon & Riley) who offer a 'Top Tip' by promoting the awareness of using fat traps for fats and cooking oils. It starts with a child saying 'don't pour fat down the sink'. He then talks about using a fat trap, or a tin can, for fats and oils from cooking. He advises the audience to allow the liquid to cool down before pouring into the trap which he then demonstrates. A child then holds a water unit pipe whilst explaining how the fats and oils could be trapped and cause blockages in pipes and sewers. There is then a STW web link at the end. It is forty three seconds long and available on YouTube.

This is a light hearted campaign featuring children but aimed at adults who do the cooking. It is successful in raising awareness of fats and oils because it has a visual impact and informs its audience in a short video. It also has the benefit of being used over a longer period of time, as people can access the video online and so a wider audience can be reached. The use of surveys or questionnaires as evaluation tools however would have enabled the campaign to be evaluated to measure the impact it has had on water users.

In addition to a lack of quantitative data, the concept of children educating adults in a mildly humorous way may not be transferrable to Saudi society.

Severn Trent Water (unknown) 'Bag it, Bin it – video'. Available at:

<http://www.stwater.co.uk/households/pipes-leaks-and-drains/protecting-your-drains/>

2: Anglian Water:

A: Drop 20 campaign:

This is an online campaign with accompanying leaflets, aiming to inform consumers about saving water for the future. It is aimed at all water users and details how 20 litres can be saved through some simple changes in behaviour. It contains facts such as 'At home, we each use an average of 145 litres of water a day. Some of that could easily be saved. Imagine if everyone in your house, your neighbours and in your community dropped that amount by 20 litres, every single day. That's a lot of water saved for tomorrow.' The website also contains a lot of tips to reduce water wastage in the home such as 'Drop 3 litres by fixing that dripping tap and save up to three litres per day. Drop 5 litres by putting a free save-a-flush device in your toilet cistern. Drop 10 litres by only washing full loads of laundry'.

The accompanying leaflet is very colourful and vibrant, explaining how 20 litres of water a day could be saved through a range of simple water saving techniques, in the kitchen, the bathroom and outdoors. Significantly, water conservation is explained, using a range of facts. Finally, customers are advised as to how they can calculate their daily water usage. The leaflet proved very successful as a visual campaign, aimed at all water customers and presenting a range of techniques suitable for all audiences.

This sort of campaign would be useful as a model for a similar campaign in the KSA. It includes facts that would help the public make simple changes in behaviours that would not interrupt daily routines, but at the same time underlines the importance of these changes. Importantly, it explains that some of the water saving devices (also indicated by the data from the questionnaires) should be targeted by the awareness campaigns. The fact that the campaign took account of different audiences is also important, as there was a tendency in the data for the Saudi public to be viewed as a homogenous group.

Finally, the ability to calculate one's own usage would be empowering and encourage a sense of responsibility, though the UK's use of water meters would also play a part in motivating people to save water. Metering had been suggested by some engineers and academics, and also as part of a sanction for over use by some members of the public, but on the whole had been an unpopular suggestion. It is significant therefore that the UK companies do not see that metering alone is enough to encourage a sense of responsibility. Empowerment and knowledge must also play a part.

Anglian Water (2013) 'Drop 20 campaign'. Available at:

<<http://www.anglianwater.co.uk/environment/using-water-wisely/join-drop-20.aspx>>

B: Water efficient products:

This campaign is about promoting free water efficient products for Anglian Customers in order to save water, energy and money. This includes products such as a "Save-a-flush Freddie" which can be inserted in the toilet cistern and can save up to 1 litre of water with every flush. The aim of the campaign is to save water in the home using these products. It is targeted at home owners who are already motivated in some way to save water and the products are free for customers of Anglian Water. The research data in this thesis has shown that there is a segment of Saudi society who are also prepared to use water saving devices if they are provided free. This suggests that this campaign has the potential to be applied to the KSA.

However, the programme was not evaluated. Due to the lack of evaluation tools used to measure the impact and effectiveness of the campaign (for example there were no interviews or surveys with customers), it is not possible to comment on the success of the programmes in changing behaviours in the long term. However, with further research, such a campaign may provide a useful model to promote water saving devices.

Anglian Water (unknown) 'Water efficient products'. Available at <http://www.anglianwater.co.uk/environment/using-water-wisely/we-products.aspx>

C: "Keep water healthy":

This is a new campaign to help all customers to keep their tap water healthy. It aims to raise awareness of things in the home that can lead to contamination getting into the water that people use for drinking, cooking and washing. It is a knowledge-based campaign that aims to help customers address such problems. It discusses poor plumbing, worn out washers and even cheap kettles that are actually the source of some complaints to Anglian Water.

The campaign was conducted following a recent rise in complaints about the quality of the water and presented some common complaints as problem that could be easily fixed at home. It mentions problems such as water tasting 'medicinal' and explains that this is often caused by cheap, plastic kettles. The solution suggested is to try boiling water in a pan to see if the taste disappears, so customers could carry out this test before complaining.

It is linked to another website which provides further information in the form of an interactive house that customers use to learn how to keep water healthy around the home. This campaign was designed to appeal to a wide range of audiences and aimed to be colourful, engaging and interactive. Some sections are linked to videos which are very informative. There was no

evaluation carried out following this campaign as it was targeted specifically at water quality problems.

With respect to the Saudi situation, many complaints concern major problems such as the interruptions to supply. However, an interactive house would certainly have potential, particularly in schools, to teach about water and perhaps could also address the issue of a lack of knowledge about how much water is required in household tasks. This problem had featured strongly in the data from the public.

Anglian Water (2013) 'Keep Water healthy!' Available at:

<<http://www.anglianwater.co.uk/news/general/77B898261DC443D8BB761E543A1E9C69.aspx>
x

3: Wessex Water

A: Charity and community work:

Wessex Water aims to work with local communities to help raise awareness on water issues such as water conservation, in order to keep communities informed of work they are doing in their area and to help improve the environment. This includes voluntary community investment and work with a wide range of charities, both within the region and internationally. For example one project involves the Wessex Watermark awards which offer environmental grants to a wide range of groups, schools, councils and other organisations within the region. Local projects during 2011-2012 included:

- Contributing towards the creation of an outdoor environment area for a school where children will plant and grow their own vegetables
- Transforming rambling routes along one of Somerset's oldest railway lines into teaching trails, providing a sustainable environment for wildlife and informing members and visitors
- Assisting in the production of around 100 vegetable boxes for the local community

- Creating a dipping platform to promote a hands-on appreciation of local wildlife at the Nail sea Environment and Wildlife Trust.

This has been very successful due to funding that was made available for communities who are able to take an active role in their local area and who are motivated to promote awareness about protecting the environment. With respect to the Saudi situation, although there are not the same structures for funding, there is scope for using peoples' religious duties towards voluntary work. Campaigns to value resources and the environment could be organised through mosques.

Wessex Water (2012) Charity and community work. Available at:

<<http://www.wessexwater.co.uk/sustainability/employees/default.aspx?id=3442>>

B: Wessex4West Africa

Wessex Water has raised more than £8.5m over the last 29 years in support of the charity Water Aid which works to provide communities around the world with access to clean water and safe sanitation. They launched the Wessex for West Africa (W4WA) in 2008, to increase support WaterAid and to generate money to support future projects. The initiative between Wessex Water and its key suppliers also aims to raise support for WaterAid throughout West Africa by inviting companies to become more involved with the charity. At the same time, these partners are raising awareness within their own organisations. This has been a very successful partnership, as since 2008 and up to the end of 2012, the scheme will have raised more than £450,000 to help the world's poorest in accessing clean water.

In terms of evaluation, the charity campaign aimed to raise awareness of water users in the world through charitable efforts. It also aimed to influence the attitudes of water users to see water as a scarce and valuable resource. Its funds are evidence of its success, but no evaluation tools have been utilised to measure positive impacts on water use in Wessex' own communities. The use of interviews would have been beneficial to measure the qualitative effects of protecting the environment in addition to raising money for worldwide users.

Several academics expressed the view that the Saudi public are self-interested with respect to water use. The media could be used to share information about water scarcity around the world in order to encourage people to see water as a scarce and valuable resource.

Wessex Water (2013) 'Wessex4West Africa' Available at:

<<http://www.wessexwater.co.uk/about/threecol.aspx?id=2856&linkidentifier=id&itemid=2856>ht
tp://www.wessexwater.co.uk/sustainability/employees/default.aspx?id=3442>



C: Online Video Campaigns:

A video featuring Luke Fenton from Wessex Water summaries the various campaigns that have been used over the years to raise awareness both of the services provided by the company and of water conservation. This includes formats such as computer games, posters, and physical stalls with information boards. The online video features a cartoon based game which is aimed at children and young people. It aims to promote water conservation to customers through the "Bag it, Bin it, don't flush it" campaign. This is in an interactive computer game which enables younger users to understand the consequences of putting the wrong things down the toilet. It also gives Wessex Water staff the opportunity to provide face-to-face information about services they provide. The factual information on the game encourages the proper disposal of fats, oils and grease in order to avoid causing blockages to the water network. Presumably, the information could then be passed onto parents.

This proved successful as a marketing strategy and also in getting the information out there in a format designed to appeal to young people. Again, it is an example of an interactive game that could be used in Saudi schools to raise awareness and increase knowledge, which could prepare the children as parents of the future (a concern expressed in the teachers' data). This

strategy however was only one in a whole range of activities designed to promote awareness and engagement.

Wessex Water (2013) 'Online video' Available at:

<http://www.wessexwater.co.uk/about/threecol.aspx?id=2856&linkidentifier=id&itemid=2856>

D: "Target Twenty - Are you on track to save water?"

This campaign had similarities with Anglian Water's Drop 20, in that it encourages customers to save 20 litres of water per person per day through making simple changes to their behaviours, but with one important difference, in that it includes a pledge for customers. This consists of a checklist to complete online and then submit. It advises on saving water in the bathroom, kitchen and the garden. For example one suggestion advises consumers to: '**Save up to 18 litres per day** – turn off the tap while brushing your teeth. 7 out of 10 of our customers already do this'. In this way the data from the submitted pledges motivates the other users to make savings, which can then in turn be used to evaluate the campaign.



Target Twenty pledge

Support our Target Twenty campaign by pledging to save at least 20 litres of water using the checklist below.

1. Pledge to save **at least 20 litres** in the checklist below
2. Fill in your details and click submit

BATHROOM

- Save up to 18 litres per day** – turn off the tap while brushing your teeth. 7 out of 10 of our customers already do this.
- Save 8 litres** – take one minute less in the shower and save on your energy bills too. Request a [FREE shower regulator](#) or buy a [low flow showerhead](#) and reduce the excess flow from your showerhead.
- Save 5 litres a day** – put a [Save a Flush](#) device in the toilet.
- Save 6 litres a flush** – avoid unnecessary flushing after every visit to the toilet.

[Target Twenty pledge: in the bathroom](#)

The online campaign is supported by the “Target Twenty” video which features Luke Fenton from Wessex Water, enabling customers to ask questions, interact with Wessex Water and generate new water-saving ideas. This is an award winning campaign, which is repeated on a yearly basis. It is a useful model in that it is multi-media and designed to encourage consumers to take responsibility and monitor their own usage. This form of campaign could work in different environments and could also provide a model to use in schools, so teachers (as they had discussed in their data) could have a means of monitoring children’s awareness and commitment to conservation.

Fenton, Luke (2014) ‘Target Twenty’ Wessex Water video campaign. Available online at:
<http://www.wessexwater.co.uk/videolibrary/vidplay.aspx?id=8878>

E: ‘Don’t flush it , bag it and bin it’:

This is similar to Severn Trent’s campaign, but this version is directed more towards adult customers. However it is targeted towards a range of consumers, aiming to raise awareness of how to prevent blockages. The campaign material is a four page leaflet that is quite graphic about its message. The first page features an image of an employee with a quantity of household waste that had been removed from a sewer, having been flushed down a household toilet. It lists all items that cause blockages if they are flushed away, or poured down the sink, including wet wipes, sanitary products, cooking fats and oil. Consumers are then advised as to how to dispose of these safely and prevent blockages. Fats and cooking oils are shown being left to cool and put in a container for disposal in the household waste. Steve Goodman is shown leading a team who are clearing blocked sewers stating: ‘It’s mainly sanitary products, wet wipes and cooking fat that cause blockages’. These are all common household products and consumers are again encouraged to make small changes to their behaviour that will make a significant difference. The leaflet also includes a comprehensive checklist of items that should be disposed of in the household waste such as nappies, dental floss, bandages, needles and medicines.

The visual images were effective in this campaign as they served to remind people of the consequences of everyday actions and in the case of the blocked sewers, were very memorable. The checklist could also be kept in the kitchen as a constant reminder.

There is contact information for customers via website and phone if they would like more advice. It was a successful leaflet campaign because it combined strong imagery with advice and help lines. It did not 'blame' customers, but offered advice to keep them engaged.

Again, no evaluation tools have been used to examine the effectiveness of the campaign. A follow up survey or focus group would have been beneficial to measure the change in customers' behaviour and attitude towards water efficiency.

Wessex Water (2013) 'Don't flush it, bag and bin it' leaflet campaign, Available via the main website, online at: <<http://www.wessexwater.co.uk/customers/>>

4: Thames Water

A: 'Fit to Drink' campaign:

This was a campaign to reduce the use of bottled water. It was organised in collaboration with the London Sustainability Exchange, following findings that some communities, particularly migrant communities, were buying bottled water because they were unaware that tap water was drinkable. It was aimed at schools in six London Boroughs including Enfield, Croydon, Islington, Tower Hamlets, Lambeth and Haringey. It was designed as a competition and pupils were asked to come up with a new design to go on the Thames Water sports bottle to encourage youngsters to drink water. Schools were then asked to complete a short survey about tap water so Thames Water could understand perceptions and attitudes towards drinking tap water instead of bottled water.

45 schools registered for the competition and 15 entries were sent in for judging. The top school from each borough joined Thames Water director Piers Clark at Abbey Mills pumping station to take part in a final presentation and a tour of the site. Eversley Primary School from Enfield took the top prize, winning a Hydra chill machine for the school and their design is featured on the official Thames Water sports bottle. The runners up each received water bottles for all pupils in their schools, featuring their runner up design.

The issue of how migrant workers behave towards water is a concern that was flagged up in the data several times. Awareness campaigns such as this could be specifically targeted towards this group, perhaps with an incentive, so that they may also develop a sense of responsibility through knowledge. Of course this particular campaign was targeted specifically towards children so that they could pass on the messages to their families, so it could be adapted to engage Saudi school children too. Another probable reason for the success of this Thames water campaign was that it utilised different themes and events, which are listed below:

- **The Olympics theme** – tying the competition into the Olympics was an important factor for schools, with 71% of teachers saying this is what motivated them to take part.
- **Curriculum links** – the competition was not actively promoted as supporting the curriculum, however it linked with a number of Key Stage 2 subject areas (i.e. art and design, physical education, design and technology and citizenship) and 49% of teachers stated that this is what motivated them to take part.
- **Environmental messaging** – it was evident during the winning pupil presentations that schools were aware of the environmental implications of drinking bottled water and valued the positive environmental impacts that drinking tap water could achieve.
- **Tap water awareness** – based on survey responses and the key messages during the pupil presentations the project materials and communications were effective in spreading awareness about the quality of London's tap water.

As a result of the successful campaign, Thames Water are currently developing a 'Fit to Drink!' teacher resource pack for primary schools which will be available online free of charge for schools across the area. The online resource includes a film featuring Olympic Gold Medal list Andy Triggs-Hodge, who explains his reasons for drinking water when training as a rower. Activity sheets and teacher notes in addition to an interactive online game will accompany the film. The resource includes curriculum links and is aimed at pupils aged 7-11 years-old.

In terms of evaluation, Thames Water targeted the data to measure what motivated schools to participate in the project, as listed above. They did not gather data based on the numbers who had switched to tap water. The reason may be that this was a one off campaign, rather than an on-going study. A longer term campaign may have facilitated some longitudinal research to measure a longer term reduction in drinking bottled water.

Thames Water (2012) 'Promoting our product - 'Fit to Drink' campaign'. Available online at <http://www.thameswater.co.uk/CR/Preciousresource/Promotingourproduct/index.html>

B: Water Aid Fundraising – Thames 4 Bangladesh':

Thames4 Bangladesh, like Wessex 4 West Africa, is a campaign in support of the charity Water Aid. The fundraising campaign aims unite both customers and employees in helping some of the world's poorest people to gain access to clean water and safe sanitation.

The Thames Water Aid Steering Committee sets fundraising targets and strategies each year, and meets regularly to review progress and recognise achievements. In 2012/13 they exceeded the fundraising target of £500,000 for the second year running by raising more than £532,000. Half of this funding goes towards 'Thames4 Bangladesh', a four-year campaign aimed at helping four towns to improve their access to clean water and sanitation. The four towns are Paikgacha (situated in the coastal belt of south Bangladesh with 17,000 residents), Fulbaria (where only 36 per cent of 33,000 residents have access to sanitation), Shakhipur (in central Bangladesh, with 40,000 residents) and Kalaroa (in south west Bangladesh). Rather than simply building infrastructures in the towns, local communities were asked what facilities they needed and educated on how to maintain them. Thames Water works with WaterAid to ensure all the money raised is put to the best possible use. They also visit each of the towns annually to review progress.

Thames Water has various events for fundraising, where during 2012/13 employees ran the following. The information is taken from the link on the page following:

- Three employees challenged themselves to parachute from over two miles high for the annual WaterAid sky dive. They helped raise nearly £8,000 for the Thames 4 Bangladesh campaign
- The London 5-20 Challenge saw more than 80 members of staff from across the company walk a five-mile route around London carrying 20 litres of water, raising £8,000. The aim of the Challenge was to raise awareness of the fact that 5 miles is the typical distance covered to find water and 20 litres is the volume of water carried by millions of women and girls every day in developing countries
- The Big Fat Cheesy quiz ran heats across the business with the final held in Reading, raising £34,000 with the help contractors
- Thames Water's 16th annual Reading Raft Race to help raise funds for WaterAid where 30 teams battled it out on the River Thames raising £41,000.
- The WaterAid staff lottery, managed by employee volunteers raised £59,000
- Thames Water received £56,846 from new customer donations

The campaigns have been so successful that during October 2012, Thames Water collected a prestigious award for bringing safe water and sanitation to people in four Bangladeshi towns. WaterAid were awarded the President's Award signed by the Prince of Wales.

The campaign's success was measured in the amount of money they were able to fundraise and also from the annual visits to review progress of the projects. Thames water did not gather data around an evaluation of water efficiency nor did they carry out surveys, interviews and focus groups that may have been useful in capturing the recipients' views towards the safe clean water available to them. Instead, Thames Water chose annual visits and progress reviews to evaluate the project.

Thames Water (2012) 'Water Aid Fundraising campaign'. Available online at
 <<http://www.thameswater.co.uk/CR/Responsibleoperations/Communityinvestment/WaterAidfundraising/index.html>>
 <<http://www.thameswater.co.uk/CR/Preciousresource/Promotingourproduct/index.html>>

C: Water efficiency campaigns - Save Water Swindon

'Save Water Swindon', in partnership with the World Wildlife Fund (WWF) and Water wise, was a year-long campaign running throughout 2012/13. This project aimed to challenge domestic and other users to reduce their daily water use in order to protect water levels in the River Kennet. Save Water Swindon is the UK's first single-town campaign to encourage people to use less water. The campaign was so successful that it won the Environment Agency Chairman's Award at the UK Water Efficiency Awards 2012. Alan Alexander, Chairman of Water wise said:

The wide-ranging partnership established for Save Water Swindon is impressive, and it is commendable that Thames Water has initiated a whole-town project – the first of its kind in the UK. It is an excellent example of a small-scale, ambitious project being taken forward to develop a bigger and better programme of work. (Alan Alexander)

Moreover, Rose Timlett, Fresh Water Programme Manager of WWF-UK quoted:

It is a real pleasure to have been working with a water company who, with our help, has gone the extra mile in achieving measurable results to benefit local rivers and the wildlife they support. (Rose Timlett)

The campaign was an example of how saving water can work in partnership with wider environmental issues, raising awareness of how the urban water cycle can affect local resources.

D: 'Care for the Kennet'

This was a community-led initiative in partnership with a local group, Action for the River Kennet (ARK). It was targeted at communities in the upper Kennet valley (Marlborough, Hungerford and villages). It aimed to help customers understand more about the river and make the link between the river and their water supply through reducing their water use. It was highly successful as at the UK Water Efficiency Awards 2012, 'Care for the Kennet' was named best community-led initiative at the UK Water Efficiency Awards.

Projects such as Care for the Kennet are vitally important if we are to protect river environments for the benefit of local communities, fish and other wildlife. I hope that the award for this project will help highlight the need for us to do much more to protect

the flow and water quality of chalk streams. (Mark Lloyd, Chief Executive, Angling Trust)

In 2012, there were also campaigns involving local school communities to raise awareness of water conservation. It was very successful as two schools persuaded almost half their communities to request free domestic water-saving products or home makeovers. Schools were also offered smart meters to take control of their own water efficiency.

The above campaigns aimed to raise awareness of water savings and hence improve knowledge and understanding of customers. Due to the nature of the campaigns, there was no evaluation tools used to measure any impact, though the number of free water saving devices that were distributed provides some quantifiable data. Both campaigns raised awareness of the urban water cycle so that residents would develop an understanding of how personal use can impact on a renewable water supply. Communities were effectively engaged with the process and such a campaign could possibly be modified to raise awareness in cities in the KSA about the stress that usage can place on their own non-renewable water supplies.

Thames Water (2012) 'Water efficiency campaigns – Care for the Kennet' Available online at <<http://www.thameswater.co.uk/CR/Preciousresource/Usingwaterwisely/Waterefficiencycampaigns/index.html>>

5: Northumbrian Water

A: 'Love your drain' campaign. News release: 'Grease has had its chips'

This campaign is another that promotes awareness of drains and pipes being blocked as a result of household waste being flushed in the toilet and cooking oils and fats drained in the sink. Like the campaigns discussed earlier, it aimed to raise consumers' awareness that only human waste and toilet paper should be flushed away and any non-biological products disposed of with the household waste. Other simple changes in behaviour were shown, such as scraping grease from pans and roasting tins before washing up or placing them in a dishwasher.

The campaign was aimed at adults and also children through the message 'love your drain' and a green cartoon like figure who featured as a mascot for younger audiences. The campaign was supported by bloggers offering household tips and an online video in which the messages were reinforced by employees.

'National Chip Week', like 'love your drain', makes use of a humorous, mildly ironic language in order to engage the public. Its aim was to reduce the blockage of drains by fats and oil through showing how as they cools, they can congeal, harden and restrict the flow of wastewater, resulting in blockages. Reducing blockages in fat-filled drains and tackling sewer flooding is one of Northumbrian Water's top priorities. In 2013 the company spent more than £100,000 clearing nearly 2,000 blockages from greasy liquids such as cooking oil, butter, meat fats and sauces being poured down sinks or drains. Again, the campaign aimed to encourage small changes in behaviours that would make a significant difference to maintaining the infrastructure of the sewer system.

In terms of evaluating this campaign, Northumbria water measured their success during the first year of the campaign (2012) and could report back to customers that due to the 'Love your drain' campaign there was a 13% reduction in the number of blockages, but no further evaluation was conducted by the company, as its main priority had been awareness raising. This is supported by Northumbrian Water's wastewater director Richard Warneford who commented:

The campaign, and especially our mascot Dwaine Pipe, have received a fantastic reception from our customers of all ages from day one and this shows in the reduction in blockages we've seen so far. (Richard Warneford)

Northumbrian Water - 'Love your drain' campaign (2012) Available at:

<<https://www.nwl.co.uk/your-home/your-services/love-your-drain.aspx>>

Northumbrian Water - News release: 'Grease has had its chips' (2013) Available at:
<https://www.nwl.co.uk/media-centre/611_4422.aspx>

6: South West Water

A: Falmouth Raw sewage campaign

This campaign discovered, and prevented, thousands of litres of raw sewage flowing directly from hundreds of homes and businesses into the wrong drains and out to sea. Customers and businesses complained of a bad smell in Falmouth. South West Water and its partners then surveyed the local sewage network using CCTV equipment and dye testing to find its source. They discovered that more than 300 properties in the town were wrongly connected to the surface water drainage system. Waste water from the properties' toilets and sinks had been flowing into surface water drains - designed to collect run-off from roofs, roads and pavements - causing the unpleasant smell and discharging untreated sewage into the sea.

Once the misconnected pipe work was found, South West Water worked to connect the properties correctly to the foul sewer, which takes waste water for treatment at Falmouth Sewage Treatment Works. South West Water Sewerage Engineer Ian MacFarlane said:

Several weeks of investigation and repair work has resulted in finding the sources of this odour and pollution. The owners of the properties would have had no idea they had accidentally been causing problems, but thankfully we have been able to put it right. Residents and businesses in the area should notice a great improvement. (Ian MacFarlane)

Mark Pilcher, Environment Management team leader from the Environment Agency, praised the company for its prompt response to resolve the problem. He said:

The Environment Agency are really encouraged to see the extent of the investigation completed by South West Water. The sewer network in this area is highly complex and it is reassuring that South West Water has been able to identify the foul sewer

misconnections to the surface water drains that have been causing odour issues for local residents and businesses. (Mark Pilcher)

It was a successful campaign because South West Water identified the problem, and reduced the risk of untreated sewage being discharged to the sensitive environment of the Falmouth Estuary. This campaign did not require research, but it needed effective partnerships and good communication with customers. It is evidence of the necessity to update and repair the infrastructure, which is a source of concern to many of the engineers in the KSA who responded to the questionnaires. It is also another example of how campaigns can be more successful if water issues are linked to wider environmental concerns, one of the tenets of integrated urban water management.

South West Water (2011) 'Falmouth smells sweeter thanks to South West Water campaign'.

Available online at:

<<http://www.southwestwater.co.uk/index.cfm?articleid=8650&rangeq=3&rangey=2011>>

7: Southern Water

Fat, Oil and grease awareness campaign:

This was another awareness campaign addressing a key issue, which adversely affects the sewage system. It aimed to raise awareness of how pouring fat, oil and grease down the drain can lead to flooding and pollution. It informed customers that a build-up of fat in sewers can cause blockages, resulting in wastewater backing up and overflowing into homes and gardens. Again, consumers are encouraged to see how their actions impact on the infrastructure and they are advised to make changes to their behaviours.

The campaign was supported by an online video which encourages customers to bin all non-biodegradable products (nappies, wipes, cotton buds, bandages, cat litter etc.) and not to flush these, reinforcing the 'bin it don't block it' message. They also advise customers 'to keep drains

fat free' by highlighting the danger of putting fat, oil and grease down the sink as it blocks sewers and can lead to pollution in rivers and seas. Southern Water attended local town festivals to promote the message and educate customers in protecting the water network. They reported positive feedback from the public.

In terms of evaluating this campaign, there was no research carried out prior or during the campaign as it aimed to raise awareness of the causes of flooding and pollution. Southern Water did not capture qualitative data of the views of customers, thus they did not build up a picture of how the campaign may have influenced changes in behaviour, other than through anecdotal evidence. What is significant, however, is that several water companies have organised similar campaigns to target this problem that affects the whole water infrastructure. Perhaps there is evidence that it could benefit from a national plan to tackle blockages. More information about Southern Water's campaign is found in the link below.

Southern Water (2011) 'Our environment: Fat, oil and grease' Available online at:
<<http://www.southernwater.co.uk/reports/stakeholder2012/our-environment/fat-oil-and-grease.asp>>

Southern Water – Saving water – Films:'A pleasant and water efficient day' Available online at:
<<https://www.southernwater.co.uk/saving-water-water-efficient-day>>

8: United Utilities

A guide to using water wisely:

This is a 16-page leaflet campaign aimed at all

water customers, raising awareness about effective water use. It includes tips and advice to assist customers to save water and money. The guide also contains a self-audit checklist to help consumers to calculate their average water consumption. The leaflet targets different

behaviours around the house and garden. It then offers advice for customers to reduce water waste such as putting a plug in the sink whilst washing, filling the kettle with only as much water needed, replacing washers in dripping taps, and washing with a full load of clothes. The leaflet also contains an illustrated diagram of how water impacts the environment. It also informs customers that they can order free water savers packs which contain a shower regulator, a save-a-flush device, a shower timer and tap inserts.

This campaign covers several points brought out by the stakeholder's data: linking water use to environmental issues, advice on rationalisation and providing free water saving devices. It could be a useful model in that one comprehensive leaflet successfully addressed several areas of concern.

United Utilities (2012) 'A guide to using water wisely'. Available online at
<http://www.unitedutilities.com/documents/A_Guide_to_Using_Water_Wisely.pdf>

9: Welsh Water
Water efficiency in the home:

There is no particular campaign, but the website contains information for customers to be more efficient in using water in the garden in more ways than the traditional hose pipe bans put in place during periods of drought. Tips include using a watering can to water plants around the base, watering the garden in the evening to reduce evaporation, using a water butt to collect rainwater from the roof and using mulch around plants to reduce evaporation.

There is also a similar information page about saving water in the bathroom such as taking showers instead of baths, putting the plug in the basin when washing, turning the tap off whilst brushing teeth, turning taps off fully, disposing of tissues in the waste bin, fixing leaks etc.

In terms of evaluating this campaign, the primary aim was to inform customers about using water efficiently in the home and garden. There was no research carried out as they intended to inform customers via their online website. It would have been useful to carry out research after the campaign to measure if the campaign had the desired effects on customers water use and to see if any water efficiencies had been made.

Welsh Water (2014) 'Be water wise in the garden'. Available online at:
<http://www.dwrcymru.com/en/My-Water/Water-Efficiency/Water-Wise-in-the-Garden.aspx>>

Welsh Water (2014) 'Be water wise in the bathroom. Available online at:
<<http://www.dwrcymru.com/en/My-Water/Water-Efficiency/Water-Wise-in-the-Bathroom.aspx>>

10: South Staffordshire Water

A: Drought planning:

The campaign took the form of forward planning for drought conditions and gave advice to customers as to what they could do to help ensure a healthy supply of water would be available in the event of a drought. This could involve the banning non-essential water use for business customers which could include watering gardens, cleaning cars or leisure boats, filling swimming pools, cleaning walls, windows, paths or patios.

For domestic users, there could be hosepipe bans and also information to promote water efficiency such as switching of the tap whilst brushing teeth, only doing a full washing/dishwashing machine load, fixing any dripping taps, etc. This is an example of a forward planning campaign that aims to make all customers feel that they are part of the process, which is important in the event of unpopular policies like hosepipe bans. Also it helps to build a sense of responsibility by reminding customers that their actions could directly affect the drought situation. The data from the KSA stakeholders showed up concerns about non-

essential water use and it was felt that at present these customers did not show a sense of responsibility. A similar awareness campaign that linked everyday actions to wider environmental consequences could be useful. However, in terms of evaluating South Staffordshire's campaign, drought conditions had not occurred at the time of writing.

South Staffordshire Water (2012) 'Drought planning' Available online at:
<http://www.south-staffs-water.co.uk/community_environment/drought_planning.asp>

11: South East Water

A: School campaign: 'Green fingered youngsters get water efficient'

This was part of an awareness campaign to promote water efficiency in a local school community in Kent. South East Water was asked to donate a water butt to use in the school garden. This would enable rainwater to be collected and used by the children where they could also learn about growing plants and food. The donation of the water butt enabled students to learn about the importance of water conservation as opposed to using treated tap water for the garden. Lee Dance from South East Water's Head of Water Resources and Environmental, said:

It was a pleasure to donate the water butt to St Michael's Pre-School. It is important that children learn from a young age how they can conserve water, not only in the home, but in the garden as well. Plants much prefer rainwater to tap water so by storing it in a water butt the young gardeners will not only benefit the environment, they should see the benefit in their plants too. (Lee Dance)

The campaign was effective because its results were visible and the children were engaged and enthusiastic. Also, gathering and harvesting was not something that these children had ever tried before. Likewise, in the KSA, gathering and harvesting water is no longer part of everyday actions as stated in the data, but it may be possible to re-introduce the techniques as part of a schools project.

South East Water (2010) School campaign: 'Green fingered youngsters get water efficient'.

Available at: <<http://www.southeastwater.co.uk/news-and-information/latest-news/2010/11/green-fingered-youngsters-get-water-efficient>>

12: Portsmouth Water

A: Water Aid campaign

This is an online campaign which encourages customers to donate towards the charity WaterAid. It is aimed at employees and customers who can donate to improve water services and sanitation for others around the world. It has been a very successful fundraising campaign as over the last 25 years, donations to WaterAid has reached a total of £250,000. This is related to the 2012 campaign where employees from Portsmouth Water climbed mountains in order to raise funds for WaterAid. In addition to helping the global community, these campaigns can also remind consumers how fortunate they are in having access to a clean and reliable water supply. This could enable the public to be more receptive to conservation.

Portsmouth Water - Water Aid campaign (on-going). Available at <<http://www.portsmouthwater.co.uk/about-us/default2.aspx?id=1418>>

13: Essex & Suffolk Water:

A: Charity campaign – 'Six peaks for WaterAid'

This campaign aimed to raise funds for the charity WaterAid. The water companies raise large amounts of water to provide safe drinking water, effective sanitation and hygiene education in 27 countries in Africa, Asia and the Pacific region. This charity campaign involved employees walking up the highest mountains in the UK, Ireland and the Isle of Man in 72 hours during July 2012 to support WaterAid's projects in Bangladesh. It represents a good example of how the different companies can work together effectively globally and also locally, as both employees

and customers in the local communities took part, encouraging a sense of ownership with their water company.

The six peaks climbed were: Snaefell (Isle of Man), Snowdon (Wales), Scafell Pike (England), Ben Nevis (Scotland), SlieveDonar (Ulster) and CorranTuathail (Ireland). Craig Holliday from Essex & Suffolk Water said:

To go there and see how people are surviving on a daily basis without access to safe drinking water and sanitation was a hugely life changing experience. For me personally it is really important to be able to come back and raise awareness and funds to support the work that WaterAid does in countries like Bangladesh. The Six Peaks Challenge is going to be a very testing event for myself and the team and I'm very much looking forward to it. (Craig Holliday)

Essex and Suffolk Water's Daniel Wilson said:

Essex & Suffolk Water have a long tradition of supporting WaterAid through various initiatives. This challenge, one of the tougher WaterAid challenges, will raise thousands of pounds to support communities across the world and provide water and sanitation facilities to those in need. (Daniel Wilson)

The fundraising campaigns continue to be successful due to the impact they have in providing safe water for the poorer countries of the world and also in the way they can encourage their own customers to appreciate their own access to water.

Essex and Suffolk Water 'News release: Six peaks for WaterAid' charity campaign (2012).

Available online at: <https://www.eswater.co.uk/media-centre/3190_3577.aspx>

14: Northumbrian Water

A: 'Love your drain' campaign , News release: 'Grease has had its chips'

This campaign is about promoting awareness of blocked drains and pipes as a result of household waste being flushed in the toilet in addition to cooking oils and fats drained in the sink. It informs customers that only toilet paper, urine and poo should be flushed away; any

other non-biological waste such as wipes, nappies, cotton buds, wool, dental floss, contact lenses etc. should be disposed of in household waste. It then discusses how to keep drains clear by scraping grease from plates, pans and roasting trays before washing up. It encourages people to 'love their drains' and features a green cartoon like figure who acts as a mascot for younger audiences. This will help customers understand the correct things that can be flushed safely away. It then features people who are online bloggers and share their environmental tips in support of the campaign. The message is also repeated by employees on an online video in order to prevent blockages by putting disposable products in the waste bin.

The news release is about the campaign for 'National Chip Week' to keep drains clear of fats, oil and grease. It aims to highlight the damage that can be caused by pouring cooking oil or fat down sinks or drains, leading to blocked drains. It informs customers that grease may not look harmful while it is being poured into the sink, but as it cools it can congeal, harden and restrict the flow of wastewater. This can eventually lead to pipes becoming blocked. Reducing blockages in fat-filled drains and tackling sewer flooding is one of Northumbrian Water's top priorities. In 2013 the company spent more than £100,000 clearing nearly 2,000 blockages from greasy liquids such as cooking oil, butter, meat fats and sauces being poured down sinks or drains.

The 2012 'Love your drain' campaign was successful because it led to a 13% reduction in the number of blockages in its first year. This is supported by Northumbrian Water's wastewater director Richard Warneford who said: "The campaign, and especially our mascot Dwaine Pipe, have received a fantastic reception from our customers of all ages from day one and this shows in the reduction in blockages we've seen so far."

Northumbrian Water - 'Love your drain' campaign (2012) Available at:
<<https://www.nwl.co.uk/your-home/your-services/love-your-drain.aspx>>

Northumbrian Water - News release: 'Grease has had its chips' (2013) Available at:
https://www.nwl.co.uk/media-centre/611_4422.aspx

Scientific activities of the author

- I have been participating in the Second Arab Water Forum, which was held in Cairo, Egypt, during the period from 20 to 23, November 2011.
- I have been participating in the Arab Water Council, 3rd General Assembly 26-28 Feb 2013, Cairo. Based on my participation the Arab Water Council selected me as a member of its board of governors.
- I presented a poster at the faculty annual research symposium which was held in February 2014.
- I participated and gave an oral presentation at the the 15 (IWA) International Water Association water professionals conference on 23rd to 25th of April 2014.

Publications arising from the research presented in this thesis

- Alsaluli, A., Ahmed, A., and Davies, J. (2015) 'Public engagement in integrated urban water management in Saudi Arabia: teachers' perceptions in relation to water awareness', *Water Science & Technology: Water Supply* 15 (4): 871-880; DOI: 10.2166/ws.2015.006

Publications in preparation

- The status of integrated urban water management (IUWM) in Saudi Arabia: water managers' industrial managers', environmental managers', water engineers' and academics' views with respect to water issues'.
- Water awareness in Saudi Arabia: the general public attitudes to water issues
- The United Kingdom experience and its relevance to the practice of IUWM: identification of opportunities for transferring learning from UK experiences to the Saudi situation.