

Public Perceptions and Attitudes Towards the Declining Water Level of the Dead Sea Basin: A Multi-Cultural Analysis

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Abstract

This paper presents the results of survey research on how people perceive the problem of the shrinking Dead Sea. Our approach emphasizes the concerns and priorities of residents on all sides of the basin. Correlational analysis between survey responses and socio-economic and socio-demographic factors were analyzed. This work is the first cross-cultural and multi-national environmental survey to be taken in the region. Results show how Israelis, Palestinians and Jordanians think about the issue and ways in which an equitable and sustainable solution can be found.

Keywords Dead Sea, cross-cultural analysis, water management, perceptions and attitudes

Introduction

Both national policy and research focusing on water scarcity in the Middle East take a regional or national perspective, with emphasis in the literature on alternatives to conflict (Postel 1993; Lowi 1993; Gleick 1994; Gleick 1993; Frederick 1996; Flakenmark 1986; Feitelson 2000; Lipchin 1997; Postel & Wolf 2001). Studies have and are being conducted on hydro-economic and hydro-political approaches (Wolf & Lonergan 1995; 1994) or on technological fixes (Hamberg 1995; Gavrieli et al. 2002; Shelef 1995; Segev 1995) as ways of finding solutions to water scarcity in the face of increasing demand. This study explores an as yet little studied, but critical component of the water management system in the region: the public's perceptions and attitudes toward water use.

Resource use behavior of local communities is fast becoming realized as integral to the drafting of sustainable resource policy that is advocated at a national level but implemented at a local level. Policies and programs are strengthened when they can account for linkages between local communities and national policy. Increased local participation strengthens resource behaviors that are sustainable by making the policy process more responsive to local concerns. In addition, local ownership, involvement or participation can raise awareness about resource concerns such as that of water scarcity and in so doing make programs more sustainable. A first step in this approach is the assessment of the public's perceptions and attitudes toward the resource of concern.

Successful employment of preferred policy strategies and technologies will require an understanding of the social environment in which they are to be applied. For example, the drivers which promote involvement in recycling may vary between households and cultures, and will certainly be different for domestic, commercial and industrial users. In particular, the application of water recycling systems (i.e. the procedure of locating and operating them) within households or communities, can be severely disrupted if some understanding of key factors such as perceived need and benefit is not acquired (Jeffrey 2000; Jeffrey 2000; Jeffrey & Seaton 1998). Our focus is on the variability in perceptions of, and attitudes towards, water use and the impacts of use on the ecosystem between different socio-economic, demographic and national groups.

Understanding the social and cultural dimensions of water use and management are now seen as central to the development of sustainable water management practices (Lipchin 2000; Hellstrom et al. 2000). At a practitioner level, knowledge derived from cross-cultural studies is of increasing relevance to those charged with managing and preserving our natural resources. Indeed, Hoekstra (1998) has suggested that many of the current controversies among water researchers and policy makers can be explained by the existence of different cultural perspectives (Hoekstra 1988). These perspectives differ in their underlying basic values, beliefs and assumptions (perceptions and attitudes). He also points out that many water issues

are not only technical problems but are also value laden. Hence, the path toward a solution is more complex than a simple technological “fix”.

This is because irrespective of what conclusions the scientific evidence leads to, the impressions and attitudes which the public hold can speedily and effectively bring a halt to any project or scheme (Jeffrey 2000; Jeffrey & Seaton 1998). The issues here are both complex and complicated, having to do with beliefs, attitudes and trust. Furthermore, it is important to expose the public’s own agenda for discussing and debating water problems and solutions. By conducting social enquiry at an early stage, we can test how policies and technologies might be received by individuals or groups of individuals. Subsequent feedback into technology or project design (perhaps in terms of appropriate scale, technology or location preferences) can forestall ineffective or inefficient application when the public is an equal partner in the decision making process.

Although the increasingly heterogeneous nature of our societies (at both nation state and regional levels) presents new challenges in managing water resources within a culturally diverse setting, research which can provide guidance to practitioners on such issues is sparse. As Dr. Mahmoud Abu-Zeid, president of the World Water Council has noted:” The cultural and socio-economic values of water are still a very elusive subject” (Abu-Zeid 1998).

Studies of public attitudes and perceptions to water quality and water use have been carried out since the late 1950’s (originally in the USA, but lately in Europe, Central America and Africa). Bruvold and Crook (1981) provide a valuable summary of research during these early years (Bruvold & Cook 1989), highlighting that individuals who consider their potable supplies to be under threat (in terms of either quality or quantity) or perceive an economic benefit are generally more positive towards the idea of considering conservation practices such as recycling water. Other work has demonstrated that acceptance of water conservation schemes in general is influenced by the degree of human contact associated with the reuse application. Uses such as garden irrigation and toilet flushing consistently being preferred uses over those uses for food preparation and cooking (Bruvold & Cook 1989).

The link between cultural context and attitudes to environmental and technological risk has been well articulated by Douglas & Wildavsky (1982) (1982). A review on the social bases of public concern with environmental quality has been carried out by Van Liere and Dunlap (1980). They examined the explanatory power of several sociodemographic and socioeconomic variables in explaining environmental concern. The results indicate a complex picture where it is not only the young, well-educated and liberal segments of society that display environmental concern (Van Liere & Dunlap 1980). What this and other studies show is that society is more complex than many policy makers care to consider (1998).

In water and natural resource exploitation studies in particular, cultural or ethnic background has been identified as a key indicator of both attitudes and behaviour. In a broad context, Panday (1990) has addressed the cross-cultural psychology of environmental perception and behaviour in an effort to understand how

different societies relate to their physical environments (Pandey 1990). The precise influence of cultural variables in individual attitudes towards and interactions with the water environment have been partially investigated by several authors (Murdock et al. 1988; Burmil et al. 1999), highlighting in particular, the multi-faceted role which water plays in arid and semi-arid environments. But studies which look at specific technological applications are few (for a rare exception to this trend see (Fry & Mingledorff)). Ethnicity has been shown to be a descriptor of actual water conservation behaviour (Oliver 1999), with Anglo's responding relatively poorly to voluntary conservation programmes as compared with non-Anglo populations, but equally well to mandatory conservation initiatives. Cultural factors have recently been identified as a key moderator in wastewater reuse for fish farming in Egypt (Mancy et al. 2000).

We argue therefore that projects for sustainability require a holistic and integrated approach that takes into account community measures (income, health, education) and resource measures (quality, quantity, consumption) coupled with the participation and empowerment of local communities (Hoon & Singh 1997).

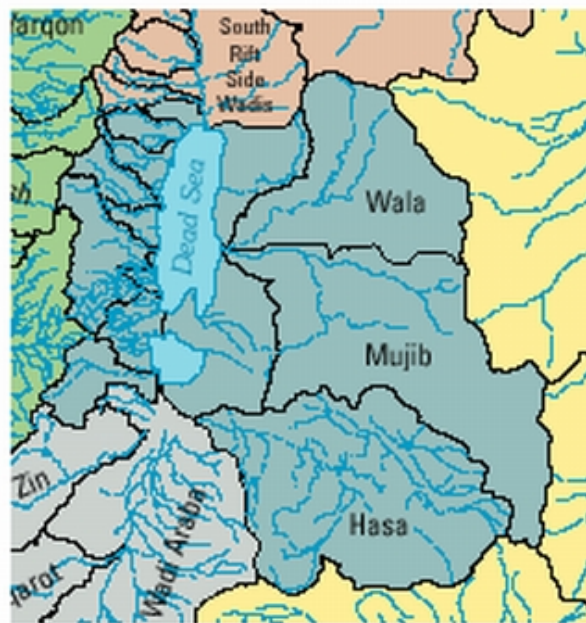
This study is thus also intended to inform the major stakeholders of the region on the importance of socioeconomic and sociodemographic factors as they influence resource use. Community measures on income, education, nutrition and health effect individual and household water consumption patterns. Spaulding (1972) showed that household status as measured by income, education and occupation, affected water consumption. Households of higher status tended to use more water than households of lower status (Spaulding 1972).

The aim of this study is to consequently explore how differences *and* commonalities in livelihood, culture and socioeconomic capacities influence attitudes and perceptions toward water use. Our field of study was the Dead Sea basin. The Dead Sea basin is a transboundary resource shared by Israelis, Palestinians and Jordanians.

Our study sought to explore the following question: How do socioeconomic and sociodemographic variables such as gender, education and income correlate with the attitudes and perceptions people hold toward water and water use policies in the Dead Sea basin?

Study Area

The Dead Sea basin has a size of about 44,000 km² and its watershed is shared by Israel, Jordan and Palestine (Figure 1).

Figure 1. The Dead Sea watershed (Assaf et al. 1998)

Major watersheds



The basin plays a major role for regional economic development. Current economic activities in the basin are industrial (mineral extraction and water bottling), tourism and agriculture. The Dead Sea's mineral composition and the unique climate provide treatment for skin diseases, especially for psoriasis and atopic dermatitis (Schempp 2000). The health and cultural features plus the unique landscape have made the area attractive for tourism. Besides the regional relevance, the basin has a global importance. Since 1998 there have been efforts to promote the Dead Sea basin as a UNESCO Man and Biosphere Reserve and a World Heritage site (Abu-Faris et al. 1999) because it is a both a unique habitat for wildlife (particularly important around springs and wadis (e.g. Ain Fashkha, Ain Gedi, Wadi Mujib) and a global cultural heritage site with some of the world's oldest human settlements.

The Dead Sea is the terminal lake of the Jordan Rift Valley. Its surface is currently about 417 m below sea level which makes it the lowest point on earth. With

a salinity of about 3,000 mg/l it is also the most saline water body in the world (Gertmann 1999). Rainfall is limited to winter months; it varies from about 500 mm/yr in the north-western highlands to less than 100 mm/yr in the valley floor (2000). Perennial storage in surface and underground water reservoirs is limited and vulnerable to pollution and depletion. Potential evapotranspiration in the valley floor is about 2,000 mm/yr, and actual evaporation from the Dead Sea surface is about 1,300-1,600 mm/yr (Stanhill 1984). The temperature is about 40°C in summer and 15°C in winter (Assaf et al. 1998). At the east and west there are steep escarpments, while in the north and south, the valley stretches gently upward along the Jordan River and along the Wadi Araba, respectively.

The historical Dead Sea consisted of two basins: the deep northern basin (which is now the only remaining Dead Sea proper), and the shallow southern basin from which the Dead Sea has retreated since 1978. The two basins were divided by the Lisan Peninsula.

The land cover is mostly open with little vegetation. Sensitive areas include the Lisan peninsula area, marshlands and wetlands at the northern and southern ends of the Dead Sea, the Wadi Mujib, the Ain Gedi oasis, and the Dead Sea itself (Fariz 2002). Lack of natural freshwater, expansion of human settlements, and inappropriate land use has affected these areas (Gebetsroither et al.).

Waste waters from local domestic, agricultural, industrial and tourist activities flow directly into the Dead Sea. Raw sewage flows into the Dead Sea from Jerusalem-Bethlehem urban areas via the Wadi Nar (Kidron valley). Water shortage and land degradation are a problem all over the basin and these are likely to exacerbate with population growth (Rishmawi & Hrimat).

The most visible and most disturbing degradation is the decline of the Dead Sea water level and volume. Since around 1930 the water level of the Dead Sea has fallen by about 25 m, about half of this alone in the last 20 years (Anati. D.A. & Shasha 1989; Assaf et al. 1998). In the past few years the rate of decline was 80-100 cm per year. The last available data from mid-2003 indicate a water level of -417 m (Figure 2). As a result of this decline, in the last 20 years the Dead Sea surface area has shrunk by about 30 %, and its north-south extent has shrunk from over 75 to 55 km (Anati. D.A. & Shasha 1989). Since 1978, the Dead Sea has completely retreated from the southern basin, which presently consists only of artificial evaporation ponds used by the mineral extraction industry.

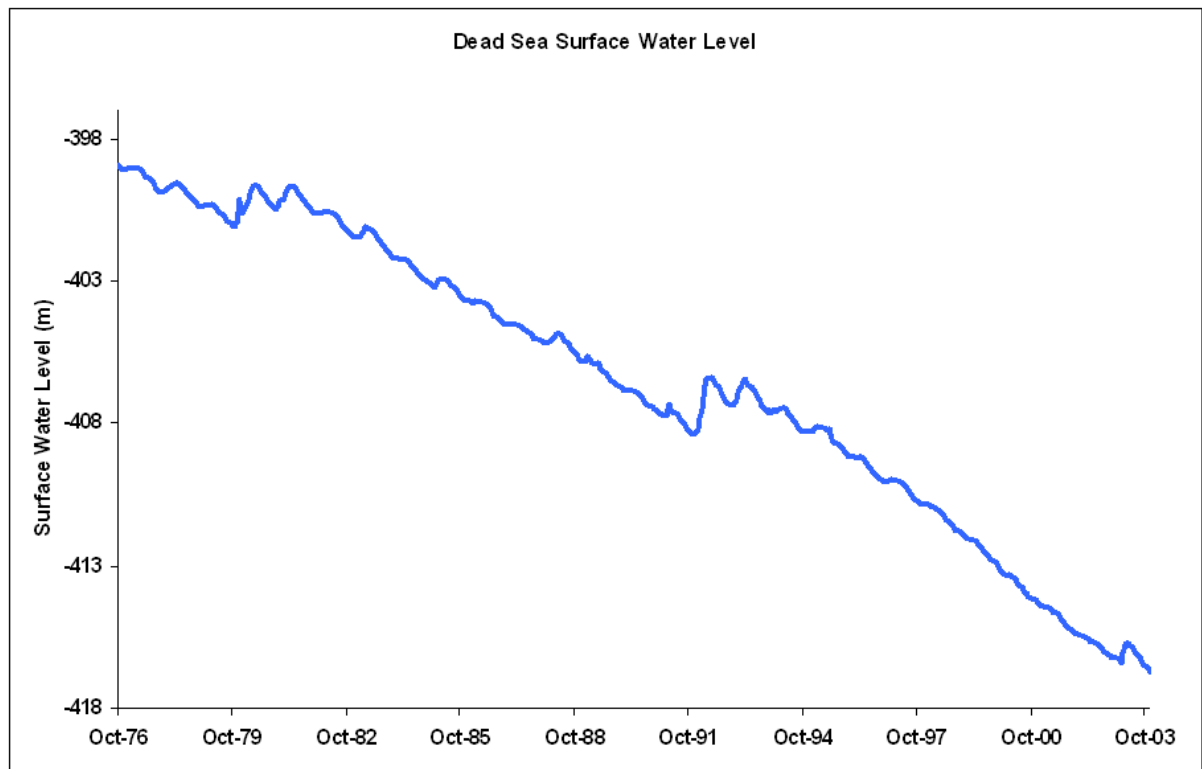


Figure 2. Decline of Dead Sea water level 1976-2003 (Data from Israeli Hydrological Service)

The reasons for this decline are well-known. First and foremost, the decline is a direct consequence of the declining freshwater input: this includes decreasing discharge from the River Jordan, increasing water use from natural springs and side wadis, and extensive use of aquifers that provide secondary water input (Klein). Of all these factors, the River Jordan probably plays the biggest role (Lipchin 1997). It may be said that the Dead Sea's steady disappearance is a direct result of the water management strategies of the River Jordan riparians (Tal 2001). While 100 years ago the River Jordan's discharge into the Dead Sea was about 1,200-1,300 million cubic meters per year (MCM/yr) of freshwater, it has been reduced to about 900 MCM/yr by the 1940's and now is not more than 100-200 MCM/yr of saline and polluted water (Orthofer 2001; 1994; Al-Weshah 2000; Orthofer et al. 2001; Rabi ; Shavit 2001). The main reason for this decline is that water from the Upper Jordan River as well as water from the Lower Jordan River tributaries (e.g. Yarmouk, Zarqa) has been blocked and diverted for urban and agricultural uses inside and outside the watershed.

On top of the reduced freshwater input, more than 200 MCM/yr water are pumped out of the Dead Sea into evaporation ponds in the shallow southern basin. It is estimated that the salt industries contributes 25 to 30 % of the present total evaporation rates (Wardam 2000).

It is not clear whether the Dead Sea water level has now come to equilibrium between the reduced surface and a reduced evaporation, or if it will continue to decline. As a result of the lowering of the water level, the adjacent aquifers are

seriously affected (Yeichieli 1996). Sinkholes have opened up along the shoreline, caused by lowered water tables and groundwater over-exploitation (Baer et al. 2002; Bowman et al. 2000). Furthermore, the decline of the Dead Sea also affects the freshwater springs on its shores (e.g. Ain Fashkha and Ain Turiba) that support a unique biodiversity (East 2000; EcoPeace 1998). The decline of the water level has also had a serious effect on tourism due to the disappearance of the shoreline close to the hotels.

Without some form of intervention, the current trend is expected to continue with potential disastrous effects for the future. The growing population in all three countries will increase the pressure for the freshwater that currently remains unused. The possible re-settlement of returning Palestinian refugees will also increase demand in Palestine. Palestinians demand as part of a regional water agreement that more water should be allowed to the Lower Jordan River and that this additional water should be usable for the Palestinian population. This, of course, means that the Dead Sea would not benefit. The declining Dead Sea undermines the potential as a tourist destination, despite the enormous investment in hotel and resort infrastructures in Israel and in Jordan. Over the next few years, there are plans for further tourism and industrial development including the construction of over 50,000 new hotel rooms (Meunier 1999). For the fledgling Palestinian economy, the present state of the Dead Sea suggests that Palestinians may never have the opportunity to develop what should have been one of their more attractive tourist locations that could provide critical employment to a growing workforce.

In all three countries, development policies have disregarded impacts on the environment, indigenous people and small farmers. Essential water needs for nature were neglected; policies lacked incentives to promote local forms of environmental security and equitable access to natural goods and services. Water is increasingly allocated to the urban sector and to large-scale agriculture at the expense of the needs and rights of the rural and indigenous people. Consequently, the rural poor and indigenous are overexploiting land resources to sustain their livelihoods.

Furthermore, the decline of the Dead Sea raises ethical issues regarding the exploitation of present generations of water resources at the expense of the natural heritage in the future. Many would argue that it represents an intolerable violation of the rights of future generations.

Nonetheless there is concern in the region about the threat of a disappearing Dead Sea (Coussin 2001; EcoPeace 1998), but very little progress. Most options for solving the environmental and economical problems focus on the provision of “new water from outside”, particularly through the building of a canal that will connect the Red Sea with the Dead Sea (“Red-Dead Canal”) (Gavrieli et al. 2002). This is a classical technological “fix” solution indicative of a centralized management structure with little public involvement. Both Israeli and Jordanian governments support this type of option (recently, the Israeli government has shown less enthusiasm as it explores desalination plants on the Mediterranean coast). This 240 km conduit is expected to replenish the missing inflow from the Jordan River, use the gravity

pressure for desalination through reverse osmosis, and for production of electricity. Costs are estimated to be around 3 billion dollars (Pearce 1995). Among the questions which remain unclear are the environmental impacts of the canal, e.g. the chemical changes of the water and the economic viability of the project.

Our study seeks to go beyond the centralized approach by approaching the problem from a more holistic and inclusive perspective. We seek to find out from the public where they stand on the issues. What are their needs and priorities? What is important to them and what alternatives are they willing to support? We also want to understand how one's social context influences one's perceptions and attitudes towards the declining water levels of the Dead Sea basin. We believe that this approach is valuable to policy makers in providing clues on what types of interventions and programs may elicit public acceptance or rejection.

Residents of the Dead Sea Basin

Israelis, Palestinians and Jordanians reside within the Dead Sea basin. The three publics differ culturally, economically and politically. The Israeli public has by far the lowest population density within the basin. The total population of residents is approximately 1,500 individuals. The majority of the residents reside in agricultural settlements (kibbutzim or moshavim in Hebrew). The region is divided into two regional authorities. The southern Tamar regional authority is located within Israel's pre-1967 borders whereas the northern Megillot regional authority is beyond the post-1967 borders. Any peace agreement with the Palestinians will most likely result in a shift in Israeli demographics in the basin. Date farming for export is the most profitable agricultural activity. Food crops, primarily vegetable crops, are also grown. The largest industrial activity is the Dead Sea Works which extracts minerals from the Dead Sea and is the world's fourth largest producer and supplier of potash products. Tourism is also an important contributor to the local economy. Most of the employees of the Dead Sea Works and of the hotels come from outside of the basin.

The Palestinian population in the study area resides in urban and rural communities as well as in refugee camps. The total Palestinian population in the study area as of 2002 was 512,238. Most of the communities are located in the western part of the Dead Sea basin, whereas the eastern part is sparsely populated. Economic activities are local scale agriculture including livestock farming (sheep and goats), stone quarrying and olive oil pressing. Manufacturing and service related industries are practiced in the urban centres.

On the Jordanian side of the Dead Sea population estimates are approximately 54,000 people. Rural farming is the dominant activity. Both fruits and vegetables are grown. According to land area cultivated, lemons, olives, tomatoes and beans are the dominant crops. The rural farming community is estimated at 53,000 people. The Arab Potash Company is located at the southern end of the Dead Sea and produces similar products to that of the Dead Sea Works in Israel. The company employs 300

people who live on the premises. There are also three hotels on the Jordanian side of the Dead Sea.

Research Design

The research was conducted using a survey questionnaire targeted at the residents of the Dead Sea basin in Israel, Palestine and Jordan. The survey instrument consisted of a combination of dichotomous choice and close-ended questions to address (a) water use and consumption habitats, (b) knowledge of water supply and demand infrastructure in the Dead Sea basin, (c) support for conservation practices and willingness to pay for such practices and, (d) the importance of international cooperation in future management of the Dead Sea.

The dichotomous choice section on water use and consumption habitats used a 5-point Likert scale (1 for strongly agree to 5 for strongly disagree with 3 being neutral). The other sections of the questionnaire used close-ended questions. Responses were coded for statistical analysis. The final section of the questionnaire gathered socioeconomic and sociodemographic information from the respondents. Pre-testing of the survey was conducted with an expert evaluator from Tel Aviv University. The questionnaire was translated into Hebrew and Arabic with slight variations in survey design according to cultural norms. A group of volunteers, residents of the basin, and supervised by the authors, disseminated the questionnaires to the residents who were asked to fill out the questionnaire and return it the next day. A random representative sample of both urban and rural residents of the basin were selected (Table 1). The chi square test for statistical significance was used to test for relationships between survey responses and socioeconomic and sociodemographic variables. Tests for significance were conducted for three variables: sex, income, and education. Cross-cultural analyses were also conducted among Israeli, Palestinian and Jordanian respondents. Results for which statistical differences were found are discussed below.

TABLE 1 Population Surveyed in the Dead Sea Basin

Country	Population	Sample Size	Confidence Level	Confidence Interval
Palestine	512,238	741	95%	±4
Israel	1,408	176	95%	±7
Jordan	53,300	623	95%	±5
Total	566,946	1,540		

Public Perceptions and Attitudes in Relation to One's Sex

Men and women think and respond differently with regards environmental issues (Wilson & Daly 1998; Wilson et al. 1996; UNDP 2003). This is due to both psychological and social factors (Wilson & Daly 1998; Wilson et al. 1996). It is important therefore to elicit these differences when planning for management options.

Israeli, Palestinian and Jordanian men and women responded differently to different sets of questions about the Dead Sea.

In Israel, more men than women thought that there is enough water in the Dead Sea basin to support agricultural practices for many years to come (30.8% men : 14.8% women; $\chi^2=6.360$, $p<.05$). This despite the result that more men than women were aware of the Dead Sea's decline (83.5% men : 69.1% women; $\chi^2=4.585$, $p<.05$). Men, more so than women agreed that their drinking water came from the same supply as that used for agriculture and industry (60.8% men : 35.8% women; $\chi^2=13.912$, $p<.001$).

In Palestine, more women than men agreed that local industry is important for the Dead Sea basin even if it consumes a lot of water (54.3% men : 72.4% women; $\chi^2=22.211$ $p<.001$). Yet, more men than women had heard of the planned "Red-Dead" canal project (46.3% men : 28.6% women; $\chi^2=19.860$ $p<.001$).

For Jordanians, when asked about the sustainability of domestic water supplies in the basin they responded similarly to Israelis when asked about the sustainability of water for agriculture. Men, more so than women, were confident that there is enough water now and in the future to meet the needs of the community (40.8% men : 23.1% women; $\chi^2=18.884$ $p<.001$).

The most interesting results are those where there is convergence among Israeli, Palestinian and Jordanian respondents. Results such as these can contribute to the implementation of watershed based management plans for the Dead Sea. Table 2 summarizes these results.

TABLE 2 Survey Responses According to Sex

Statement	Countries	Response (%)	Significance
There is enough water in the Dead Sea basin to support current agricultural practices for many years to come	Israel	30.8% men : 14.8% women	$p<.05$
	Jordan	47.9% men : 35.2% women	$p<.001$
Awareness of Dead Sea level dropping	Israel	83.5% men : 69.1% women	$p<.05$
	Jordan	62.0% men : 40.8% women	$p<.001$
The Dead Sea is a national resource	Israel	57.0% men : 35.7 % women	$p<.05$
	Jordan	39.6% men : 20.9 % women	$p<.001$
Opinions on the use of groundwater in the Dead Sea basin	Israel	67.6% men : 41.0% women favored pumping at current rates to meet present needs	$p<.001$
	Palestine	43.4% men : 33.3% women favored pumping at current rates to meet present needs	$p<.05$
Israel is mostly responsible for the drop of the water level of the Dead Sea	Israel	35.5% men : 19.0 % women	$p<.001$
	Palestine	45.0% men : 33.0 % women	$p<.001$
	Jordan	27.5% men : 16.7 % women	$p<.001$

Public Perceptions and Attitudes in Relation to One's Income

Is income a contributing factor to how people perceive environmental issues? We tested the hypothesis that those with greater economic means have a greater perception of the problems and potential solutions facing the Dead Sea than those less fortunate than them. We controlled for differences in economic capacity among the three countries using average per capita income per household as the controlling variable. We used four income categories: very low, low, median and high (Figure 3).

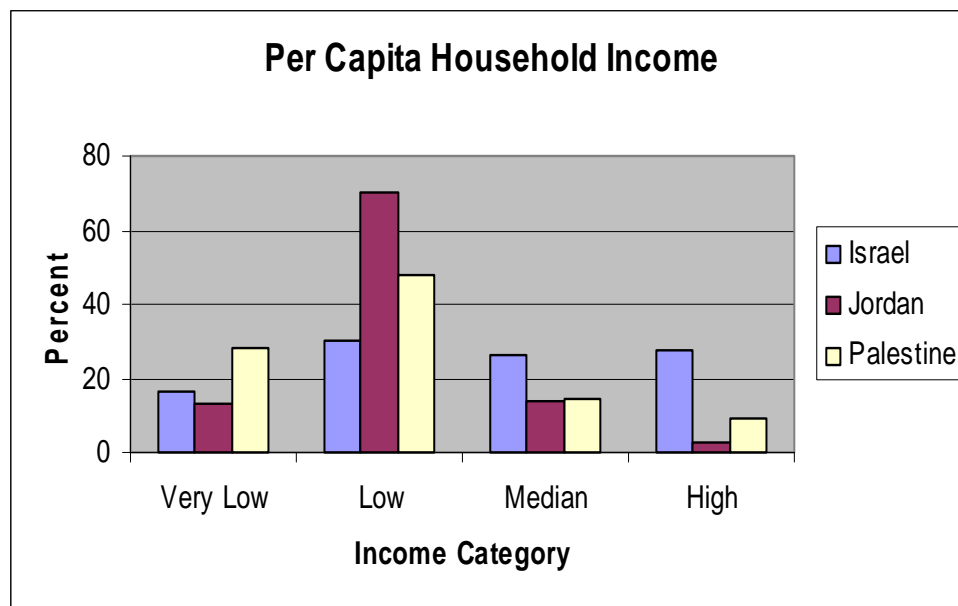


Figure 3: Distribution of Income Categories in the Dead Sea Basin.

In Israel, those with lower income means are more concerned than those with higher income means about water quantity issues. In response to the statement that there is enough water in the Dead Sea basin to meet the needs for agriculture in the region 60% of low income respondents disagreed with this statement as opposed to 47.1% of high income households ($\chi^2=13.556$ $p<.05$). In contrast, when it came to water quality issues 58.8% of high income households agreed that water quality is a serious problem as opposed to 25.0% of low income households ($\chi^2=12.751$ $p<.05$).

For Palestinians, we found the opposite result with regards water quantity. Here, 50.0% of high income households felt that there was not enough water to meet the needs of agriculture as opposed to 27.3% of low income households ($\chi^2=30.200$ $p<.05$). With regards water quality, Jordanians also responded differently than Israelis. 73.7% of low income households agreed that water quality is a problem. For high income households it was 56.3% ($\chi^2=19.828$ $p<.001$). These differences serve to highlight the socioeconomic dimension of water management and use as well as providing insight of where to focus policy decisions (see below for discussion).

In Israel, high income households agreed that local industry is important for the Dead Sea region (81.8% high income; 45.0% low income; $\chi^2=24.509$ $p<.001$). For Jordanians, 69.1% of low income households agreed that local industry is important for the Dead Sea region in comparison to 46.7% of high income households ($\chi^2=16.877$ $p<.05$).

A proxy for knowledge about the characteristics of one's water is knowing the source of one's drinking water. In the Israeli portion of the Dead Sea basin drinking water comes from the same supply as water that is used for agriculture and industry although it is treated differently. This is because all water in the region is groundwater. In this regard our hypothesis was confirmed as 66.7% of high income households were aware of this fact as opposed to only 15.0% of low income households ($\chi^2=19.511$ $p<.001$). We found no significant differences for Jordanians or Palestinians.

For Palestinians, more so than Israelis and Jordanians, income was a significant factor in shaping their attitudes and perceptions towards water in the Dead Sea basin. We found significant differences in 40% of the cases in the Palestinian survey and only 14% of such cases for the Israeli and Jordanian surveys. 50.0% of high income Palestinian households responded that they could reduce the amount of water used in their households but only 25.1% of low income households felt that they could do so ($\chi^2=21.557$ $p<.05$). An available option to dealing with water shortages is to treat sewage water to the point where it is safe for human consumption. 41.2% of low income families in Palestine indicated that this is an acceptable solution, no more than 33.3% of high income families supported it ($\chi^2=29.192$ $p<.001$). Again, as mentioned above, there does seem to be a link between income and knowledge about the state of the Dead Sea. 83.3% of high income Palestinian households noted that the Dead Sea water level is dropping considerably, 59.4% of low income households said the same ($\chi^2=10.937$ $p<.05$). In exploring this issue a little further we asked whether or not people thought there is a link between the declining water levels and their quality of life. High income households tended to say yes and low income households tended to say no (43.3% yes for high income : 25.7% yes for low income; $\chi^2=17.736$ $p<.05$). In addition, high income households (46.7%) more so than low income households (28.9%), viewed the Dead Sea basin as a national Palestinian resource ($\chi^2=28.648$ $p<.001$).

Decisions concerning groundwater management in the basin are critical. The over abstraction of groundwater has contributed to the appearance of sinkholes along the Dead Sea's shores (Gavrieli et al. 2002). Simply put there are two options in managing ground water: keep pumping at current rates or reduce pumping out of concern for the water table. 41.5% of low income Palestinian households prefer the "keep pumping" options whereas 66.7% of high income households chose the "reduce pumping" option ($\chi^2=18.202$ $p<.05$). Finally, in Palestine, people more so from high income (56.7%) than low income (44.1%) households felt that international cooperation was the preferred means for managing the Dead Sea basin ($\chi^2=21.944$ $p<.05$).

Public Perceptions and Attitudes in Relation to One's Education

Similar to income, education can play a role in how one perceives and relates to environmental issues (Van Liere & Dunlap 1980; Murdock et al. 1988; Spaulding 1972; Simon 1971). As for income, we hypothesized that a higher level of education contributes to a greater perception of the problems and potential solutions facing the Dead Sea. Because of the different educational approaches and philosophies among the three countries we divided education into two categories: those with a high school diploma or less and those with a university degree. For the three nationalities sampled the proportion of those without and with a university education were approximately two-thirds to a third.

For Israelis, education played a role in people's perception about governance in the Dead Sea basin. Those with a university education (64.2%) as opposed to those without (34.6), disfavored government restrictions on how much water a household can use ($\chi^2=12.578$ $p<.001$). When asked about which governing body should make the decisions about the future of the Dead Sea basin, university educated Israelis preferred international bodies (50.9%) whereas those without a university degree were split between national authorities (31.4%) and international bodies (37.1%; $\chi^2=8.067$ $p<.05$). Neither group had much faith in local authorities (16.2% for high school or less; 7.5% for university degree).

Education was a strong predictor for Palestinian and Jordanian responses. In both communities university educated people felt that water quality was less of a problem than those without a university degree (Jordan: $\chi^2=11.270$ $p<.001$; Palestine: $\chi^2=9.507$ $p<.05$). The same pattern was observed with regards people's willingness to reduce water use in the home. University educated Jordanians and Palestinians indicated that this would prove difficult but less educated respondents felt that they could perhaps reduce domestic water use (Jordan: $\chi^2=10.096$ $p<.001$; Palestine: $\chi^2=8.099$ $p<.05$).

Education also played a role in these communities in how people view the Dead Sea. For Jordanians, less educated people tended to view the Dead Sea as a Middle Eastern resource while better educated people tended to view it as a national resource ($\chi^2=19.004$ $p<.001$). In Palestine, less educated people tended to view the Dead Sea as an international resource more so than well educated people and like the Jordanians, well educated people favored the opinion of the Dead Sea as a national resource in comparison with those with less education ($\chi^2=13.275$ $p<.001$).

Our hypothesis was confirmed when we correlated education with whether or not respondents had heard about the Red-Dead canal project. In both the Palestinian and Jordanian samples more university educated people had heard about the project than non-university educated people (Jordan: $\chi^2=122.693$ $p<.001$; Palestine: $\chi^2=10.717$ $p<.05$).

Discussion

People think differently about water. In our study, sex, income and education all influence the way in which people perceive and value water resources in the Dead Sea basin. Differences and similarities can be found between Israelis, Palestinians and Jordanians. The data also reveal a complex picture in which socioeconomic and sociodemographic variables interact with the perceptions and attitudes people hold toward the declining Dead Sea water levels.

Our results indicate that the correlation between one's sex and perceptions and attitudes is robust across nationalities. It seems that independent of nationality men are more inclined to be sanguine about the future of the Dead Sea even though they were more aware than women on the declining water levels. Women on the other hand were more attuned to the present impact of water use practices on available groundwater resources. Men were more inclined to discount the future in favor of present pumping rates. Men also felt more strongly than women that the Dead Sea is a national resource and were more inclined to blame Israel for the sea's decline than women.

These results are meaningful. Besides indicating differences between men and women, that are for the most part, independent of national identity, they offer insight into what kinds of policies may be acceptable whether one is a man or a woman. Our data indicate that women are more inclined to consider conservation practices while men are comfortable with the status quo. Education programs and conservation campaigns that take these sex differences into account may therefore prove to be more successful than those that do not.

Income and education present a more complex picture. Here differences were found among the three publics. In many cases the data reveal more questions than answers in for example why wealthy Israelis are less concerned about water quantity but that wealthy Palestinians find this a topic of concern. Teasing apart the reasons behind these responses requires in-depth anthropological and sociological study. We have simply revealed the complexity inherent in a society where one's social context is an important predictor or "shaper" of one's perceptions and attitudes. What we can say is that society, any society, should not be seen as a homogenous unit, as was once considered by early anthropologists, but that there are important individual differences within a society. We suggest therefore that policy makers take a closer look at the heterogeneity in society and the ways in which this heterogeneity shapes perceptions and attitudes.

Institutional, social, gender and economic issues related to water management options for the Dead Sea basin are thus far more complex than what is currently envisioned by engineers and policy makers. These issues need to be addressed adequately to achieve equitable and sustainable water management. As we tease apart the many layers by which people in any society act and interact, we need a greater degree of precision on how people think about an issue.

In the case of the Middle East in general and the Dead Sea basin in particular, the centralization of the water management system provides policy makers with a clouded lens on how people respond to current policies of water management. This lens hampers consideration of new policy structures, including more “disaggregated” (often more local) policies that may be highly effective. This study provides a starting point for such disaggregation by considering the sociodemographic and socioeconomic characteristics of communities as the foundation upon which to build sustainable water policies—rather than as passive end points of a centrally determined system.

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References

- Abu-Faris HG, Bromber G, Fariz S, Hoermann S, Turner M . Moving Towards a Dead Sea Basin Biosphere Reserve and World Heritage Listings. 1999. Amman, Jordan, Friends of the Earth Middle East.
- Abu-Zeid mA (1998) Water and Sustainable Development: The Vision for World Water, Life and the Environment. *Water Policy* 1:9-19
- Al-Weshah RA (2000) The Water Balance of the Dead Sea: An Integrated Approach. *Hydrological Processes* 14:145-154
- Anati. D.A., Shasha S (1989) Dead Sea Surface Level Changes. *Israel Journal of Earth Sciences* 38:29-38
- Assaf KK, Ben-Zvi M, Clarke JS, El-Naser H, Kesselman S, Landers MN, Nuseibeh MF, Wipperfurth CJ . Overview of Middle East Water Resources: Water Resources of Palestinian, Jordanian and Israeli Interest . 1998. US Geological Service. EXACT Middle East Water DATA Banks Project.
- Baer G, Schattner U, Wachs D, Sandwell D, Wdowinski S, Frydman S (2002) The Lowest Place on Earth is Subsiding: An InSAR Interferometric Synthetic Aperture Radar Perspective. *Geological Society of America Bulletin* 114:12-23
- Bowman D, Banet-Davidovich D, Bruins HJ, Van der Plicht J (2000) Dead Sea Shoreline Facies with Seismically Induced Soft-Sediment Deformation Structures. *Israel Journal of Earth Sciences* 49:197-214
- Bruvold WH, Cook J (1989) What the Public Thinks: Reclaiming and Reusing Wastewater. *Journal of the American Water Works Association* 77:
- Burmil S, Daniel TC, Hetherington JD (1999) Human Values and Perceptions of Water in Arid Landscape. *Landscape and Urban Planning* 44:99-109
- Coussin O . Wild and Stunning and Shrinking Fast: The Dead Sea Region is being Undermined by Industry and Tourism, but is Anybody Paying Attention? 2001. Tel Aviv, Israel.

Public Perceptions and Attitudes Towards the Dead Sea

Douglas M, Wildavsky A (1982) Risk and Culture: An Essay on the Selection of Technological and Environmental Dangers. University of California Press, Berkeley

East FotEM . Let the Dead Sea Live - Concept Document Towards the Dead Sea Basin Biosphere Reserve and World Heritage Listings. 2000. Amman, Friends of the Earth Middle East.

EcoPeace . Final Symposium Report. Symposium on Promoting an Integrated Sustainable Regional Development Plan for the Dead Sea Basin. 1998. EcoPeace-Middle East Environmental NGO Forum.

Feitelson E (2000) The Ebb and Flow of Arab-Israeli Water Conflicts: Are Past Con.

Flakenmark M (1986) Fresh Waters as a factor in Strategic Policy and Action. In: Westing A (ed) Scribner, New York,

Frederick KD . Water as a Source of International Conflict. 2000. 1996. Resources for the Future. August 28, 2000.

Fry K, Mingledorff N . Overcoming Cultural Biases in the Introduction of Water Saving Technology: No Need to Flush a Waterless Urinal. American Water Works Association, Conservation 1996.

Gavrieli I, Lensky N, Gazit-Yaari N, Oren A . The Impact of the Proposed "Peace Conduit" on the Dead Sea: Evaluation of Current Knowledge on Dead Sea-Seawater Mixing. 2002. Jerusalem, The Ministry of Regional Cooperation.

Gebetsroither E, Afaneh A, Lipchin C, Lehrer D . An Analysis of the Feedback Structure Driving Water Dynamics in the Dead Sea Region. MEDAQUA 2004 INCO-MED Water Conference.

Gertmann L . The Hydrogeography of the Dead Sea 1999-2000. 1999. Haifa, Israel, Israel Oceanographic and Limnological Research Center.

Gleick PH (1993) Water and Conflict: Fresh Water Resources and International Security. International Security 18:79-112

Gleick PH (1994) Water, War and Peace in the Middle East. Environment 36:5-41

Hamberg D . The Mediterranean-Dead Sea and The Red Sea-Dead Sea Projects. International Peace Conference on the Peace Process and the Environment . 1995.

Hellstrom D, Jeppsson U, Karrman E (2000) A Framework for System Analysis of Sustainable Urban Water Management. Environmental Impact Assessment Review 20:311-321

Hillel D (1994) Rivers of Eden: The Struggle for Water and the Quest for Peace in the Middle East. Oxford University Press, New York

Hoekstra AY (1988) Appreciation of Water: Four Perspectives. Water Policy 1:605-622

Hoon P, Singh NWS (1997) Sustainable Livelihoods: Concepts, Methods and Principles for Indicator Development. UNDP Discussion Paper

Isaac J, Hrimat N, Rishmawi K, Saad S, Abu Kubea M , Hilal J, Owawi M, Sababa G, Awad M, Ishaq F, Zboun I (2000) An Atlas of Palestine (The West Bank and Gaza). Applied Research Institute Jerusalem, Bethlehem, Palestine

Jeffrey P . Water Recycling Opportunities for City Sustainability. 2000. School of Water Sciences, Cranfield University.

Jeffrey P, Seaton R . The Theory and Practice of Exposing Public Perception of Wastewater Reuse Options. Small and Medium Size Domestic Water Conservation, Waste Water Treatment and Reuse . 1998.

Public Perceptions and Attitudes Towards the Dead Sea

Jeffrey P . Cross-Cultural Valuations of Natural Resources. A Case Study in the Galilee Region of Northern Israel. 2000. A Report to the British Council under the Lord Goodman Fellowship Scheme.

Klein C . Fluctuations of the Level of the Dead Sea and Climatic Fluctuations in the Country during Historical Times. Symposium on Scientific Basis for Water Resources Management. International Association of Hydrological Sciences.

Lipchin C . Water Scarcity, International Security and Resource Disputes-The Case of the Tigris-Euphrates and Jordan Basin River System. 1997. Ann Arbor, MI, University of Michigan.

Lipchin C (2000) Water Use in the Southern Arava Valley of Israel and Jordan: A Study of Local Perceptions. Journal of the International Institute

Lowi MR (1993) Bridging the Divide: Transboundary Resource Disputes and the Case of West Bank Water. International Security 18:113-138

Mancy KH, Fattal B, Kelada S (2000) Cultural Implications of Wastewater Reuse in Fish Farming in the Middle East. Water Science and Technology 42:235-239

Meunier J . Keeping the Dead Sea Alive: Toward a Regional Environmental Management Plan. 1999. International Development Research Center.

Murdock SH, Albrecht DE, Hamm RR, Bachman K, Parpia B . An Analysis of the Effects of Sociodemographic Factors on Daily per Capita Residential Water Use in Texas Cities. 1988. Texas Water Resources Institute, Texas A&M University.

Oliver Md (1999) Attitudes and Inaction: A Case Study of the Manifest Demographics of Urban Water Conservation. Environment and Behavior 31:372-394

Orthofer R, Daoud R, Fattal B, Ghanayem M, Isaac J , Kupfersberger H, Safar A, Salameh E, Shuval H, Wollman S . Developing Sustainable Water Management in the Jordan Valley. 2001. European Commission, DG Research.

Orthofer R . Land Use and Water Use in the Jordan Valley. 2001. Environmental Planning Department, Austrian Research Centre.

Pandey J (1990) The Environment, Culture and Behavior. In: Brislin RW (ed) Applied Cross-Cultural Psychology, vol. 14. Thousand Sage, California, USA, pp 254-277

Pearce F (1995) Raising the Dead Sea. New Scientist 33-37

Postel SL, Wolf AT (2001) Dehydrating Conflict. Foreign Policy 60-67

Postel S (1993) The Politics of Water. World Watch

Rabi A . Ecological Resources of the Dead Sea Basin and Their Sustainable Use: Problems and Cooperation between the Countries of the Basin. International Conference on Transboundary Protected Areas as a Vehicle for International Cooperation. UNEP World Conservation Monitoring Center.

Rishmawi K, Hrimat N . The use of high resolution satellite images to monitor the changes in the rates and directions of desertification in the southeastern part of the West Bank. The Second Palestinian Geographic Conference.

Schempp CHDDHBS-HJS-MESaJS (2000) Magnesium ions inhibit the antigen presenting function of human epidermal langerhans cells in vivo and in vitro. Involvement of ATPase, HLA-DR, B7 molecules, and cytokines. Journal of Investigative Dermatology 115:

Segev G . The Mediterranean-Dead Sea Canal and The Red Sea-Dead Sea canal. International Peace Conference on the Peace Process and the Environment . 1995.

Public Perceptions and Attitudes Towards the Dead Sea

Shavit URHSSAVEFIGaTB (2001) Water Sources and Quality Along the Lower Jordan Valley. In: H. Rubin (ed) Water Resources Quality: Preserving the Quality of our Water Resources Springer, Berlin, pp 127-148

Shelef G . The Coming Era of Intensive Wastewater Reuse in the Mediterranean Region. International Conference on the Peace Process and the Environment . 1995.

Simon P (1998) Tapped Out: The Coming World Crisis in Water and What We Can Do About it. Welcome Rain, New York

Simon RJ (1971) Public Attitudes Toward Population and Pollution. Public Opinion Quarterly 35:93-99

Spaulding IA (1972) Social Class and Household Water Consumption. In: Burch Jr. WR, Cheech Jr. NH, Taylor L (eds) Harper and Row, New York,

Stanhill G . Evaporation from the Dead Sea. A summary of Research untill Sept. 1984. 1984. Mediterranean Dead Sea Project.

Tal A (2001) From Development to Conservation: The Quantity and Quality of Israel's Water Resources. In: Tal A (ed) University of California Press, Berkeley,

UNDP . Mainstreaming Gender in Water Management: A Practocal Journey to Sustainability: A Resource Guide. 2003. New York, USA, UNDP.

Van Liere KD, Dunlap RE (1980) The Social Bases of Environmental Concern: A review of Hypotheses, Explanations and Empirical Evidence. Public Opinion Quarterly 44:180-197

Wardam B . Lowest Point on Earth is Getting Lower. 2000. Amman, Jordan.

Wilson M, Daly M (1998) The Evolved Psychological Apparatus of Human Decision-Making Is One Source of Environmental Problems. In: Caro T (ed) Oxford University Press, Oxford,

Wilson M, Daly M, Gordon S, Pratt A (1996) Sex Differences in Valuations of the Environment. Population and Environment: A Journal of Interdisciplinary Studies 18:143-159

Wolf A, Lonergan S (1995) Resolving Conflicts over Water Disputes in the Jordan River Basin. In: Dinar A, Loehman ET (eds) Praeger, London,

Yechieli Y . Influence of the Changes in Dead Sea Level on the Groundwaters around Israel. 1996. Israel Association Water Resources .