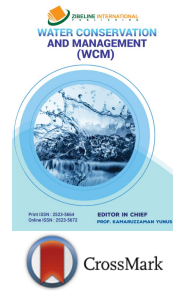




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## RESEARCH ARTICLE

# MUNICIPAL WATER SHORTAGE AND RELATED WATER ISSUES IN THE CITY OF TAJOURA: A CASE STUDY TO RAISE PUBLIC AWARENESS

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## ARTICLE DETAILS

## ABSTRACT

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Tajoura is a city located in the north western part of Libya on the Mediterranean coast, 14 kilometers east of the capital Tripoli. Like other Libyan cities Tajoura has its own concerns regarding water resources. Lack of a municipal sanitation system, excessive groundwater exploitation, disposing of waste and used chemicals in both the sea and the earth, and poor management in the municipal office have aggravated the water crisis in the city. The current investigation was based on a questionnaire survey, designed and conducted to measure public awareness of the water crisis and related consequences in Tajoura. Eleven hundred and thirty-two questionnaires were distributed and completed in person in eight localities in Tajoura. Results showed a high level of awareness in the major sections of the survey and a low level of awareness in a few questions, such as the contribution in water contamination. Ninety percent of the respondents believe that there are serious water problems in Tajoura. Concerning the municipality services, results showed that the majority of Tajoura residents have no access to the municipal water supply or sewage disposal piping systems. Seventy-one percent of the respondents chose desalination technology over a man-made river project as a strategic solution for the water shortage in Tajoura.

## KEYWORDS

Water shortage, Ground water contamination, Public awareness

## 1. INTRODUCTION

Tajoura is a developing city located 14 kilometers east of the capital Tripoli, which makes it an attractive town for residency. Tajoura's location is suitable for many workers and students. Tajoura has an area of about 494 km<sup>2</sup> with a total estimated population of about 250 000 [72% are registered residents]. During the last two decades, Tajoura has not experienced any considerable development in infrastructure such as roads and wastewater treatment facilities, and the municipality services have not been improved.

Two major water-related issues are the main concerns of the residents of Tajoura, lack of municipal drinking water piping network and lack of safe disposal of human waste and wastewater. The unavailability of a municipal sanitation system has compelled residents of Tajoura to build their own sanitation system consisting of black wells. Due to the lack of municipal water services, the main water source for the households in Tajoura is groundwater obtained via domestic private wells. Accordingly, there is a growing concern throughout Tajoura about the contamination of ground water as a result of mainly domestic underground black wells and, secondly, of seawater intrusion. Industrial pollution is another issue to be added to Tajoura's water problems. Tajoura houses a number of industrial companies/factories as well as a number of research centers. These factories may discharge large amounts of untreated industrial waste into the groundwater and into the sea.

In Tajoura, groundwater is being utilized mostly for domestic use, irrigation, and some industrial purposes and to a lesser extent for drinking. This study attempts to capture the factors influencing water supply problems and to measure the residents' willingness to pay for drinking water and their willingness to support the municipality to supply

drinking water through alternative arrangements. Furthermore, the study attempts to help public authorities and other organizations to collect data that will be useful for future investigations and studies.

## 2. METHODOLOGY

A pre-structured questionnaire survey (face-to-face interviews) was administrated to 1 132 participants across eight localities between March and October 2016. The questionnaire was specifically designed to be applicable across people with different education and backgrounds. Therefore, questionnaires were distributed at different times of day and throughout the week. Additionally, when the first attempt was unsuccessful, certain identified groups of people had to be contacted more than once.

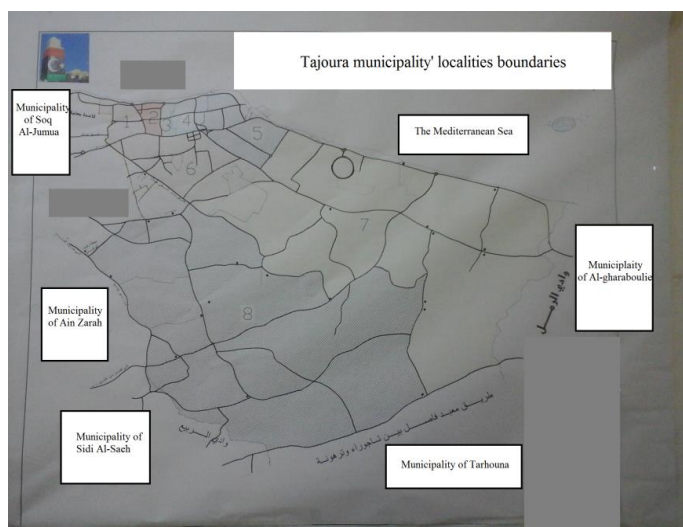
In order to avoid any misleading answers from the participants the survey was not made available online. There are some fundamental problems involved with online surveys, among of which is getting different understanding and interpretation of the questions. Without someone to explain the questionnaire fully and ensure each individual has the same understanding, results can be subjective. Respondents may also have trouble grasping the meaning of some questions that may seem clear to the author. This miscommunication can lead to skewed results [1].

On the other hand, face-to-face surveys are based on personal interaction and respondent's facial expression, reaction and body language can be observed. Furthermore, large samples of national face-to-face surveys are considered representative of the general population, while online samples are regarded as representative of population subgroups only [2-4].

The questionnaire was divided into four sections. The first section contained questions about participants' personal information such as age, qualifications and residency area. The second section comprised questions about water supply sources and related problems in Tajoura. Several questions in this section were asked to get enough information to help understand how residents react to/deal with the local water issues, for example: Do you have a domestic desalination machine? Do you have a private well? Do you buy drinking water? Do you contribute to water contamination? and Do you save water?

The third section asked questions about the residents' willingness to pay for clean and safe water and the residents' suggestions for alternative water supply sources. The Likert scale was used to measure respondents' attitudes to particular causes of water problems in Tajoura. At the end of the questionnaire, respondents were asked to write their own opinion of the reasons for the escalating water problems and water-related issues.

In order to gain adequate information about the quality of the groundwater and respective number of residents who have private water wells and black wells, the questionnaires were distributed all over the municipality of Tajoura. Figure 1 shows a simplified map of the municipality of Tajoura with its eight localities.



**Figure 1:** Tajoura municipality' localities boundaries

According to data obtained from the Tajoura municipality office, the population of Tajoura is not distributed evenly over the eight localities. Localities shown in Figure 1 and numbered 1, 2, 3, 4 and 5 have the greatest number of residents, despite having the smallest area, while localities numbered 7 and 8 have the greatest area with the smallest population.

### 2.1 Data handling and preparation for analysis

The information provided by 1 132 participants became the raw data for measuring public awareness. It has to be pointed out that all the completed questionnaires are stored and kept secured in order to be used entirely or in part for the next phase of fieldwork when it is needed. Several relevant and important comments written by the participants were distinguished and stored separately. The raw data were then entered in a Microsoft Excel spread sheet to facilitate analysis.

## 3. RESULTS AND DISCUSSION

Microsoft Excel was used for analyzing and interpreting data. The survey questions were designed in multiple choice formats, where participants select the answer that meets his/her point of view. The following are some of the important findings of the study:

### 3.1 Source of water supply

It has been known for two decades that Tajoura is one of the cities which are not connected to the main water source facilities in Libya [man-made river]. Therefore, the main source of water in Tajoura is groundwater wells.

The majority of respondents (90%) believed that Tajoura has a water crisis. Most people in the local community do know some of the details as to why it exists and the root causes of the resource deficiency. Additionally,

90% of respondents have no access to the municipal water services. As a result, residents have their own wells. Since people of Tajoura do not have other water alternatives, they consume the brackish water for daily survival. Results showed that 81% of respondents purchase bottled water from shops and desalinated water markets for drinking. However, some residents get drinking water from friends and relatives when not able to afford bottled/desalinated water. Results showed that residents who live in the Southern localities such as Al-wadi Al-sharqi and Al-wadi Al-qharbi still use their own groundwater wells for drinking and cooking, as the groundwater in these two localities are deeper and uncontaminated.

### 3.2 Public awareness of groundwater contamination

It was stated previously in this study that the majority of residents in Tajoura have their own domestic black wells for sewage disposal. The presence of these sanitation wells is one the principal sources of pollution of the groundwater in Tajoura. The distance between the water well and sanitation well in one house ranges mostly between 5 and 25 meters. This results in easy microorganism migration from the black sewage well to the water well. Accordingly, survey participants were asked whether or not this plays a role in groundwater water pollution. The results showed that only 28% of the participants agreed that it contributes to groundwater pollution. This finding proves that large percentage of people of Tajoura are unaware of the connection between the black sewage wells and groundwater wells that provide their water. This low level of awareness regarding this particular issue may lead to some serious consequences. Surprisingly, results showed that some respondents with high academic qualifications did not know of the link between the sewage wells and the groundwater wells, while some respondents with a low level of qualifications realized the impact of the short distance between the two types of wells.

### 3.3 Poor management of Municipality

For many years there has been an increased need for (i) funding, (ii) management and (iii) development of a water supply pipe network in the city of Tajoura, because of the increasing population as well as the city's increasing use of water for agriculture. However, the actions taken have not been effective, as governmental officials in charge of managing water resources have failed in multiple ways.

According to the survey results, 76% of the surveyed respondents believed that municipal officials are failing in their duties in providing water services to their citizens.

### 3.4 Public awareness of alternative water source

Respondents were asked to choose an alternative water source for drinking and domestic usage. Seventy-one percent of the respondents were very sure that desalination technology is the best option to be adopted to solve all the related water issues in Tajoura. On the other hand, 29% of the respondents chose the man-made river project (MMRP) over the desalination technology.

Respondents who chose desalination technology identified a variety of reasons, including the quality of water provided by MMRP, concern about the huge open water storage reservoirs, and, recently, violence and conflicts over some areas in the Southern part of Libya, during which the MMRP water supply was deliberately cut off many times by some rebels and protesters. Therefore, most respondents would not choose this unstable water source to be a solution for their problems.

### 3.5 Willingness to pay for a stable and sustainable water source

When respondents were asked, "Are you willing to pay a certain amount of money as official fees for safe and clean water?", 79.6 % answered "yes". One can deduce the reason behind this percentage: since 81% of the respondents are currently purchasing drinking water, it would not be an issue to them to pay a certain amount of money for more sustainable and healthier water.

### 3.6 Selected participant comments related to water problems, education, and public awareness

Some relevant and important comments written by the study participants are highlighted in the following points:

- Lack of rules or regulations on groundwater use
- Lack of monitoring/registration of shallow or small wells

- Excessive groundwater exploitation led to deterioration of water quality
- Lack of proper water supply and sanitation services turns the surroundings into polluted, unhealthy and undignified places to live in and degrades groundwater quality
- Unsafe disposal of industrial waste. Industrial waste water needs to be treated first before disposing it
- Lack of agricultural water conservation
- Lack of irrigation water use management
- Lack of public education towards water saving and rational water use
- Lack of educational level of water management, sustainable use of water resources among consumers and municipality officials
- Lack of public seminars, lectures, workshops and training courses for consumers (agriculture, industry, households and etc.)
- Lack of water tariffs
- Lack of rainwater utilization
- Population growth led to the increase of domestic black wells; thus, contamination of groundwater
- Lack of a long-term vision or plan for providing drinking water and sewage disposal

#### 4. CONCLUSIONS

Over the past three decades, Tajoura has grown from a small town to a big municipality with a population of more than 200,000 residents. As a result, commercial, agricultural, and residential land-uses have become more concentrated. On the other hand, the required wastewater and drinking water service infrastructures to meet the population growth have not improved; thus resulting in more contaminants reaching groundwater sources.

The reliance on shallow wells for providing water in Tajoura is problematic because water from these sources is mostly of poor quality. Shallow wells are easily contaminated by overflowing black wells (pit latrine), poor wastewater management and inadequate drainage systems. Dependency on such readily contaminable water sources contributes to dangerous outbreaks of such diseases as diarrhea, cholera, typhoid, dysentery and malaria.

Awareness is less when it comes to the contamination of groundwater and

high when it comes to wasting groundwater. High level of awareness was found amongst respondents concerning the alternative water source and municipal officials' duties. It is apparent that the lack of regular programs on local radio and television has affected the level of public awareness of such a vital issue.

Lack of sufficient laws and regulations on how to use and protect groundwater has led to lack of public awareness regarding rational use of water.

#### RECOMMENDATIONS

- ✓ An intensive campaign using media facilities and public seminars/workshops should be organized to increase public awareness of water problems.
- ✓ People living in and around seriously polluted groundwater areas should be fully informed about the living conditions in such areas.
- ✓ Education and communication are important. Local government officials represented by the municipal officials, need to be closer to their citizens.
- ✓ Tajoura municipality officials should realize that poor water quality affects the health and economics of their communities. Municipal officials should also realize that protecting groundwater is paramount to protecting drinking water.

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