



**Sultanate of Oman
Ministry of Education
Um Hani School/ Al Dakhalyah
Governorate**



Investigating the loss of water from government distribution networks in Samail State, its effects and the possibility of utilizing it

**Done by : Azza Yahya Al Sarmi
Fatma Said Al Daghaishi**

Supervised by: T. Nawar Mohammed Al Rawahi

February 2021

List of Content

	Page
Abstract	2
Definition of terms	4
Research questions	4
Introduction and Literature Review	4
Procedures	6
Study Site	7
Data Collection	8
Data Analysis	10
Discussing Results	14
Summary	17
Acknowledgment	18
References	19

Abstract

Investigating the loss of water from government distribution networks in Samail State, its effects and the possibility of utilizing it

Done by: Azza Yahya Al Sarmi, & Fatma Said Al Daghaishi
Um Hani School (8-12) – Sultanate of Oman/ Al Dakhalyah

The aim of the study is to investigate the loss of water from government distribution networks in the State of Samil, its effects and the possibility of utilizing it. This study was set out to answer three questions:

1. How much water is lost through the leakage of the water of government distribution networks?
2. What are the effects of leakage of government distribution networks on the environment?
3. What are the hydrological specifications for the water of government delivery networks? How can leak sites be utilized?

The research was applied to several sites for water leakage of distribution networks in Samail State. The water protocol for leaking water was applied, the rate of leakage occurred at the study sites was calculated, and the soil protocol was implemented to sample from three sites of topsoil (5-20 cm) during which the water seeps. A questionnaire was also administered to a random sample of the state's population, in addition to observing and identifying some of the effects of the leaking water.

The results revealed a large amount of water loss through the leakages of government distribution networks where the average daily loss in some locations was estimated to be (11-30) gallons. Direct observations of leak sites and responses to the questionnaire also showed that the leak had effects on the buildings extending to them such as cracks on asphalt roads and some holes. The soil at the study sites was characterized mostly by a simple alkaline (pH = 8.3) and an easy-to-turn

granular structure with clay tissue, which could be utilized in these sites for the cultivation of certain plants, especially if it is among the sites where leakage occurs frequently.

The researchers recommend that the size of leaks in the water of government distribution networks should be reduced by continuous follow-up and rapid handling of leakage sites, as well as the possibility of exploiting frequent leakage sites in agriculture.

Definition of terms

Government water:

Drinking water services are a key service in Oman's development process and therefore the Public Authority for Water (Diam) is working to provide high-quality safe drinking water through water distribution systems. (<https://www.diam.om/?lang=ar-OM>, 5/2)

Research Questions

The current study sought to answer the following questions:

1. How much water is lost through the leakage of the water of government distribution networks?
2. What are the effects of leakage of government distribution networks on the environment?
3. What are the hydrological specifications for the water of government delivery networks? How can leak sites be utilized?

Introduction and Literature Review

A group of government authorities and companies are responsible for regulating the management of the electricity, water and sanitation sectors in accordance with the legislation and laws issued in this area. The Public Authority for Electricity and Water and the Electricity Regulatory Authority, as well as many companies work together in the field of electricity distribution and water filtering. In addition, they play integrated roles to provide the necessary services to all citizens and residents.

The government is keen to provide the necessary services to citizens in a number of ways, including direct services as well as telephone services. In addition, the government provide electronic services via the Public Authority for Water (Diam) through its official website.

Some of the services provided by the Public Authority for Water include:

- Connecting a new drinking water meter

- Connecting water through distribution networks to all homes
- Connect an extra counter
- Drilling permit

Moreover, the Water Resources Protection Act was passed by Royal Decree No. (29/2000) after decree No. 82/88, which declared water to be a 'national wealth. Therefore, the government is set out a water plan and policy to increase water wealth to a greater extent than the country's aspirations in this regard. However, this does not mean abandoning rationalization policies that will continue to be the real indicator of the ability of citizens to conserve water resources. (<https://omanportal.gov.om/> , 5/2)

It is worth to mention that some newspaper articles referred to the problem of the leakage of government water through distribution networks, as stated in the article published in Al-Watan entitled: *The issue of water upset the people of the second district of Al Ansab*. According to newspaper article, the people express their annoyance with the water that accumulates in the area and affect the movement of school buses, which sometimes hinders them because of the falling soil and continuous overflow water. They suggest making streams or canals adjacent to the street, where water is utilized and invested aesthetically, especially that the quantities of wasted water are large. (<http://alwatan.com/details/108666> , 5/2)

Thus, the leakage of the water of government distribution networks is a noticeable issue that is occurred anywhere including several locations in Samail State. Consequently, this study was set out to estimate the loss of the amount of water leaked, to observe some of the effects of this leakage, and to study the soil at the leak sites to see the possibility of using it in the cultivation of trees.

Research Procedures

1. Setting a timetable for the research plan.

Table (1) Study plan schedule

Time	Work plan
January /2021	Stating the research problem and deciding on the research instruments
Weeks 1 &2 February/ 2021	Visiting study sites, collecting and analyzing data
Weeks 3&4 February/2021	Discussing the results, writing the paper and submitting it to the local committee
March/2021	Translating the paper into English and participating in the international virtual exhibition

2. Distributing the roles among the research team.

Table (2) the roles of the study team

Role	Students
Application of water protocol to samples	Azza
Ground cover protocol application	Fatma
Collecting soil samples and studying their properties	Azza & Fatma
Data analysis and research writing under the supervision of the teacher	Azza & Fatma

- Identifying and reviewing the related literature of the research topic and document them.
- Selecting and identifying study sites in preparation for the start of data collection. (Al-Madrea, Khobar, Al-Nuaima/Samail State).

- Determining the appropriate protocols for collecting research data, mainly the water protocol and the soil protocol.
- Determining the appropriate devices and tools to be used in the application of the protocols and select the necessary data. These devices include transparency tube, conductivity scale, pH meter, GPS, cups, water, paper, pen, smartphone, sample collection boxes, sieve, sensitive balance, stirring rod.
- Administrating a questionnaire using Google Forms and publishing it via social media apps to the people of the State to gather the needed information and examine the existence of the problem in the stat. (Random sample was 108 respondents)
- implementing the prescribed protocols to samples taken from the specified sites.
- Collecting data and organizing it into tables.
- Inserting the data at the program site. (www.GLOBE.gov)
- Analyzing the collected data.
- Discussing the results and the recommendations.

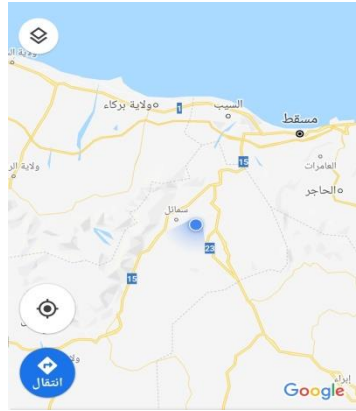
Study Site

This study was carried out in the villages of Al-Madrea, Al-Khobar, Al-Nuaima and other villages in the wilayat of Sumail in Dakhiliya Governorate. (Sultanate of Oman, Al-Dakhiliya Governorate, Sumail, February / 2021) The weather is moderate. Water and soil protocols have been implemented.)

The following table indicates the location coordinates data.

Village	Sumail
Location coordinates by GPS	23 18 00 N 57 59 00 E

The maps below show this geographical area.



Photos (1) shows the geographical areas for the study site

Data Collection and Analysis

To address the first question: How much water is lost through the leakage of the water of government distribution networks?, data were collected by measuring the rate of water lost according to the following equation: Water size (ml)/time

In addition, a related question about the amount of water leaking through government distribution networks was also included in the questionnaire to find out the needed information.



Photos (2) show measuring the rate of water leakage at the study site

To answer the second research question: What are the effects of water leakage in government distribution networks on the environment? data were collected through direct observation of some water leakage sites located on the street or the villages, and a question related to impacts such as cracks and holes was included in the published questionnaire for the state's residents.

To address the third research question: What are the hydrological specifications for the water of government delivery networks? How can leak sites be utilized? data were collected by applying the soil protocol (soil structure, soil consistency and cohesion, soil texture, presence of roots, and the presence of rocks) were applied to the on samples from some leakage sites of government distribution networks. A question was also included for the people of Samail State about their attempts to exploit the leaked water.



Photo (3) show applying the soil protocol

Data Analysis

To answer the first research question:

Table (4) shows the data collected on the amount of water leaked at some leak sites, where the water loss rate is calculated by the equation:

$$\text{size of water leaking/time}$$

Table (4) Calculation of leak rates in some locations

Location	Size of water leaking	Time	Water loss rate Size/Time
1	80 ml	1Min	80 ml/ min
2	30 ml	1Min	30 ml/ min
3	80 ml	1Min	80 ml/ min

The pie chart below illustrate the responses of the people to the following question: How long does usually the water leak last?

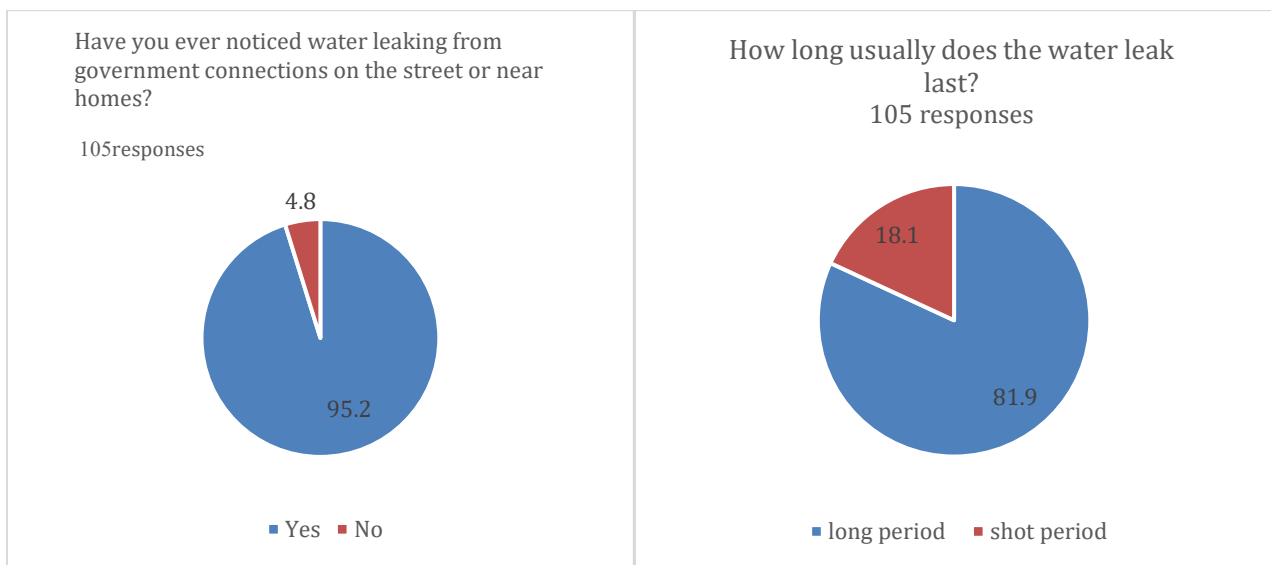


Photo (4) Pie chart illustration of the 1st & 2nd questions responses

Besides, The below graph shows the responses of the state's population to the question: How much leaking water you have observed?

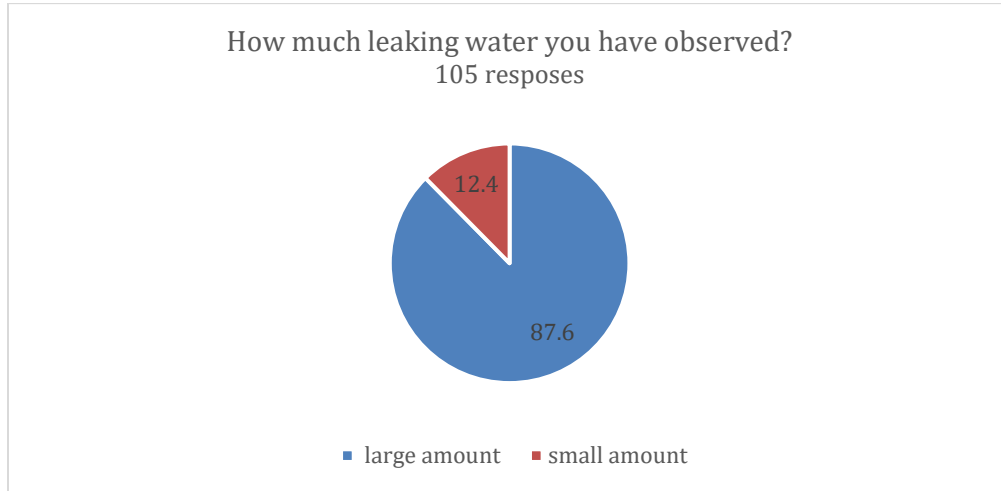


Photo (5) Pie chart illustration of the 3rd question responses

To answer the second research question: What are the effects of the leakage of government distribution networks on the environment?

The result of the direct observations of some water leak sites revealed cracks on the leaking roads, many holes and water puddles. Furthermore, buildings and walls of the houses located close to the leak sites appear to have been affected. The following images illustrate some of these effects.



Photos (6) Some effects of leaking water

The pie chart below shows the responses of the state's people to the question: Are there any negative impacts on the leak site such as cracks and holes?

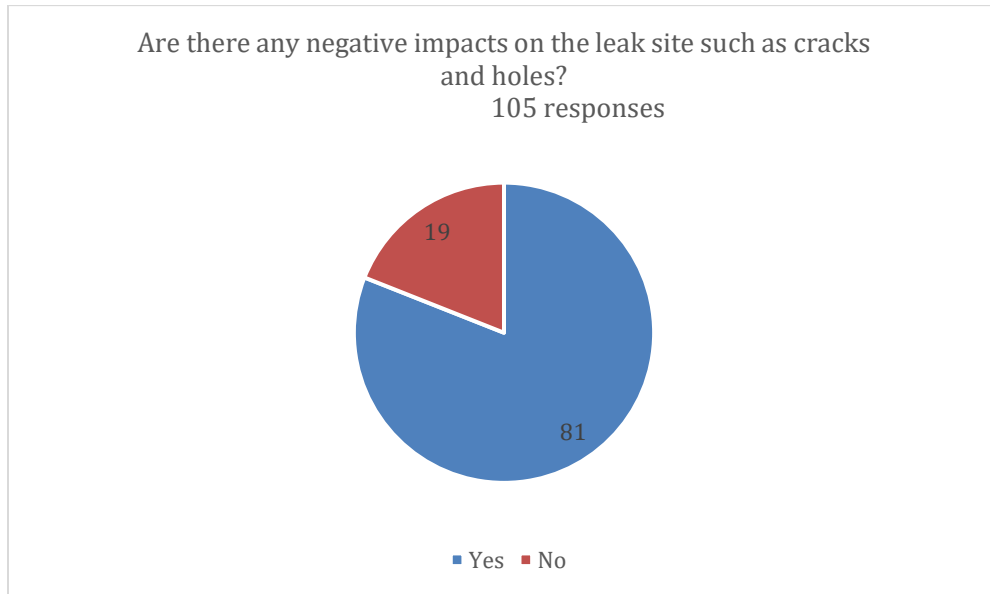


Photo (4) Pie chart illustration of the 4th question responses

To answer the third research question: What are the hydrological specifications of the water of government delivery networks? How can leak sites be utilized?)

77% of respondents reported that they did not attempt to exploit the leaking water and did not plan to do so.

Table (5) shows data on the hydrological features of government distribution networks water using GLOBE tools (21/February 2021)

Table (5) the properties of government distribution networks water

Transparency	Conductivity µs	Salinity Ppm	Acidity Ph
120 v	719	507	8.01

The following table shows some soil properties collected from the leak sites to study the extent to which permanent and recurrent water leak sites can be utilized in the cultivation of some plants.

Table (6) Physical properties of soil samples

Soil Sample	Location 1	Location 2	Location 3
Rocks	many	medium	medium
Roots	none	many	many
Soil structure	Full-intermittent	granular	granular
Soil consistency	firm	friable	friable
Soil texture	sandy	clayey	clayey

Table (7) Chemical properties of soil samples

Soil Sample	Location 1	Location 2	Location 3
Acidity	8.02	8.6	8.5
Salinity	2.56 ppm	296 ppm	300 ppm
Conductivity	3.75 μ s	405 μ s	μ s

The collected data were inserted and sent to the program website (www.GLOBE.gov) via the application (DATA ENTRY), where a new work site was added (named; Government water networks) and the collected data were inserted within it.

The GLOBE Program
Science Data Entry

120 cm

Greater than depth of Transparency Tube?

Transparency Tube Test 2

120 cm

Greater than depth of Transparency Tube?

Transparency Tube Test 3

120 cm

Greater than depth of Transparency Tube?

Comments

Save Data

The GLOBE Program
Science Data Entry

pH

Measured with: pH Meter *

pH Paper

pH Meter

1 *

If salt added, conductivity

μS/cm

pH 8.01

Value of buffers used

pH 4 pH 7 pH 10

Comments

Save Data

Photos (8) Data entry in GLOBE website

Discussing Results

Research Question One

The result of the questionnaire revealed that large amounts of water leaked from government water distribution systems were observed, with more than 87% of respondents saying that the amount of water leaking was significant.

The study team estimated the amount of water leaking through the sites studied by calculating the seeping rate per minute. It was found that the quantities ranged from 30 to 80 ml per minute, indicating a large amount of loss, amounting to (43,200-115,200) ml during the day. This amount is equivalent to (11-30) gallons of water per day from one location. Not to mention that this leakage often lasts for several days, with approximately 82% of respondents reporting that the duration of the leak lasts for a long time. This loss of water is not negligible and is a real issue that is needed to be handled.

One cannot deny that water is essential for any living being including, humans, animals or plants. It is a blessing from the grace of Allah Almighty, and the Holy Quran says: *"Indeed, in the creation of the heavens and the earth, and the alternation of the night and the day, and the [great] ships which sail through the sea with that which benefits people, and what Allāh has sent down from the heavens of rain, giving life thereby to the earth after its lifelessness and dispersing therein every [kind of] moving creature, and [His] directing of the winds and the clouds controlled between the heaven and earth are signs for a people who use reason."* (Al Baqrah, 164)

We have been advised by The Almighty to preserve this grace and not waste it. That is because as human we cannot live without water, as stated in the saying of Almighty: *"O children of Adam, take your adornment [i.e., wear your clothing] at every masjid,[366] and eat and drink, but be not excessive. Indeed, He likes not those who commit excess."* (Al-A'raf,31)

Therefore, water consumption must be rationalized to conserve natural resources and practice civilized methods in dealing with water. Yet, despite all efforts in the field of water conservation and development of its various sources, there is an urgent need to make more efforts at various levels, both by individuals and the responsible government. (<http://eau-en-tunisie.e-monsite.com/> , 22/2)

Research Question Two

The results of the questionnaire revealed that 81% of the participants reported that there are some negative effects such as drilling and cracks as a result of leakage from government distribution networks.

Moreover, the study team clearly observed the impact of these cracks on the leak sites studied, showing the extent to which the paved streets were affected by cracks, as well as the removal of exterior paint and construction distortions caused by the leaking water.

Another remarkable observation is the appearance of many grasses on leak sites, insects and frogs on the water clustered in the form of swamps. These swamps can be a cause of insects such as mosquitoes and others that can affect the people living in the area.



Photos (9) Grass growth on leak sites

Research Question Three

(Table 5) shows the results of applying the Water Protocol to find out the properties of the water distributed by government distribution networks. The water was found to be characterized by excellent transparency, pH and salinity suitable for human and agricultural use. As a result, these sites can be invested in agricultural, especially if the site is frequently leaked. Therefore, soil features from the leak sites were studied, too.

Table (7) illustrated the chemical properties of the soil. Soil acidity ranges from 8.02 to 8.6, indicating that the soil is not acidic. The data in the table (6) showed the physical characteristics of the soil. The soil is also considered unsalted, with salinization rates below 1000 ppm. In this case, most vegetables

such as tomatoes, cucumbers, peppers, etc. can be grown (agricultureegypt.com, salinity effect on vegetables, 2017)

Furthermore, the soil through which the leaking water flows in most of the sites studied was characterized by an easy-to-break granular structure with clay texture. It is well known that soils with strong consistency will be difficult for the roots to move in compared to a soil with fragile consistency that is easy to break down. (General introduction on soil research). Thus, the characteristics of most of the soil studied can be utilized in agriculturally.

Summary

The current study has explored the loss of water in government delivery networks caused by leakage. It was found that there is a significant rate of loss of water that may reach (11-30) gallons per day from one site and this took place in different sites as observed.

Regarding the effects of the leak on the environment, road drilling and cracks are visible in the leak sites. In addition, obvious cracks are also observed in the nearby buildings. Besides, water pools are created as a result of the leaking water in some sites that led to the growth of unwanted grasses and insects such as mosquitoes. The properties of water and soil through which it seeps have been studied, and it has been shown that leakage sites can be utilized in agriculture, particularly in those sites where leakage is frequent and continues for a long time.

We all agree that water is a great national wealth that must be preserved. Therefore, it is necessary to communicate quickly with government authorities who are in charge of the networks when water leakage is noticed in order to avoid water loss.

A comprehensive study of other states can be applied at the level of the Sultanate, with the aim of expanding the data and comparing it with the current study. The use of leakage sites can also be

experienced by the actual cultivation of some vegetables, observation, data recording and application of the land cover protocol.

Acknowledgment

Praise be to Allah and prayer and peace be upon His Messenger.

We would like to express our sincere gratitude to our research supervisor Teacher. Nawar Al-Rawahia, our school principal Ms. Dalal Al Nadabi for their guidance, assistance and supervision during the application of this study. We would also like to thank the people of Samail for their cooperation and for welcoming us at the study site. Thanks also go to people in the Public Authority for Water (Diam) for their assistance. Not to forget to thank the team of the GLOBE program and the program's supervisors in the Dakhiliyah Governorate for encouraging us to participate and guiding us throughout this study.

References

E-Government Development Index, Water, Electricity and Sanitation. Retrieved on 5 February 2021

from <https://omanportal.gov.om/>

GLOBE Environmental Technical Office, (2012). Field Study of Soil Research Environmental
GLOBE Program

GLOBE Environmental Technical Office, (2012). GLOBE Teacher Guide

GLOBE Environmental Technical Office, (2012). General introduction to the Soil Research
Environmental GLOBE Program

Ministry of Education (2019). Science for the seventh grade. First edition

Recommendations for the improvement and exploitation of land. Retrieved on 10 February 2020 from

<https://startimes.com>

The effect of salinity on vegetables (2017). Retrieved on 24 February 2021 from

<https://agricultureegypt.com>

The General Authority for Water. Retrieved on 5 February 2021 from [https://www.diam.om/?lang=ar-](https://www.diam.om/?lang=ar-OM)

OM

The issue of water upset the people of the second district of Al Ansab). Retrieved on 5 February 2021 from

<http://alwatan.com/details/108666>

Water is a natural asset, let's preserve it. Retrieved on 22 February 2021 from [http://eau-en-tunisie.e-](http://eau-en-tunisie.e-monsite.com/)

[monsite.com/](http://eau-en-tunisie.e-monsite.com/)