Is Groundwater the Best Source for Drinking Water in the United Arab Emirates?

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Abstract

In the United Arab Emirates (UAE), groundwater can be the best source of providing drinking water. Indeed, it can be beneficial for both the citizens and the country. In this paper, I support my position by arguing that the groundwater in the UAE is healthy for the Emirati citizens, the groundwater usage by local institutions is beneficial to the economy of the UAE, and groundwater extraction is advantageous for the environment in the UAE. I also consider alternative positions such as groundwater extraction process causes both environmental crises and groundwater is finite. I refute such claims by mentioning some of the governmental missions to prevent groundwater depletion and to avoid environmental crises. Consumers need to have the healthiest fluid because the human body is 60% composed of water, and this paper is vital because it explains which drinking water is best for these consumers.

Keywords: Groundwater, drinkable water, UAE water, Groundwater Protected Areas (GPAs), recharging water

Is Groundwater the Best Source for Drinking Water in the United Arab Emirates?

In this paper, I argue that groundwater should be the main source of drinking water in the United Arab Emirates (UAE). More specifically, using groundwater as a drinking source can benefit both the citizens and the country. Groundwater is any water that has been extracted from an underground area (Plummer et al., 2016). Since the quality of groundwater varies between countries, this paper focuses on groundwater within the UAE (Ouyang et al., 2014).

I support my position on groundwater with the following three arguments. First, I argue that groundwater in the UAE is healthy. For example, Ahmed et al. (2019) found that samples of Dubai's groundwater have high mineral counts, and Joffres et al. (1987) mentions that these minerals are beneficial to human health. Second, groundwater usage is advantageous to boost the economy of the UAE. A survey conducted by Al Blooshi et al. (2020) illustrates that 68% of Al Ain citizens agreed that using groundwater to irrigate the crops has increased the agricultural products, and more products result in increasing the gross domestic product of the country (GDP). Finally, extracting groundwater is beneficial for the environment in the UAE. Trenberth (2011) indicates that extracting groundwater to have space for new filling water can help the country in preventing floods and other similar potentially catastrophic events.

I also consider alternative positions towards groundwater. These positions include that groundwater is causing multiple environmental issues and that groundwater is limited (Erban et al., 2014; Mohammed, 2018). I refute such claims by explaining some of the actions implemented by the governments of the UAE to maintain groundwater and to prevent environmental crises associated with groundwater extraction (Dubai Municipality, 2020).

This paper is important because it concerns the public health of UAE citizens. To clarify, the human body is 60% fluid, including water, so the consumers must drink healthy and clean water (Kathleeen, 2008). These consumers can easily access drinking water since

almost all of the markets provide water. In the market, there are different types of drinking water available. However, some people may underestimate the importance of the water source they consume, and they may be unaware of their side effects. As such, it is vital to educate consumers on the water types that are the best for their health. This paper aims to persuade the Emirati citizens why groundwater is the best option available for drinking water.

Healthy Minerals in Groundwater

The minerals in the groundwater can be beneficial to an individual's health. To clarify, groundwater may contain one or more minerals, and each mineral can have different benefits to consumers. For example, patients with heart and blood pressure issues can use magnesium as a medication (Joffres et al., 1987). To elaborate, Gottlieb (1989) mentions that patients who suffer from congestive heart failure have a magnesium deficiency. Lack of magnesium causes heart failure and, consequently, affects the entire cardiovascular system.

Congestive heart failure can cause blood circulatory system disorder. Heart failure affects the blood flow because both heart and blood vessels are in the same system, which is the cardiovascular system. The blood circulatory disorder can be threatening to the patient. For instance, heart failure can cause Peripheral Artery Disease (PAD). PAD is a type of blood circulatory disorder. This disease can have multiple symptoms, such as it can fail the blood flow in the limb organ and cause limb loss (Olin & Sealove, 2010). Since patients with heart failure and blood circulation diseases need magnesium as a medication, drinking groundwater, which contains magnesium, can raise the magnesium rate in the body and prevent congestive heart failure and its symptoms.

In the UAE, groundwater contains a high rate of minerals. To clarify, groundwater should be examined to determine the proportion of the minerals and the quality of the water. Governmental institutions conducted and funded groundwater studies to provide credible and authoritative evidence. For instance, in Dubai, Ahmed et al. (2019) examined samples of Dubai's groundwater to test its quality. The authors are employees in Dubai Municipality, a

Dubai governmental institution responsible for health in Dubai's environment. The authors have conducted multiple studies on aspects of groundwater such as the chemical reactions of the elements in the water. It also examines other factors that can affect the groundwater such as the surface condition, the climate of the external environment, and the living particles in the groundwater such as bacteria. As a result, Ahmed et al. discovered that the samples contain a high level of minerals, with magnesium being one of the elements found in the sample. As the sample had a magnesium ions concentration of 182 milligrams per liter, Dubai's groundwater can be beneficial to all consumers in the country.

Groundwater Contribution to the Economy

The economy aspect is of importance to the society as a whole. Indeed, the society's happiness is directly proportional to the country's economic state (Radcliff, 2001). Therefore, it role in how to improve the economy needs to be considered.

The economy of a country is defined by its gross domestic product (GDP). The GDP is a value of the products in the country within a specific time (Kramer, 2002). As each product is defined by its price, each country's value is defined by its GDP. There are four main contributors to the GDP of the country, of which personal consumptions in the country's market is one of the main contributors (Robert et al., 2015).

Individuals' performances can increase personal consumption and contribute to great change in the economy. According to Krausmann et al. (2009), the 20th century had various historical events, such as the World War II, and inventions, such as fossil fuel. These events and inventions made the nations purchase more equipment. Consequently, the GDP of the countries that provided the required equipment has increased in the 20th century. This evidence demonstrates that any human practice can affect the GDP of the country. Therefore, the process to extracting water is one of the human practices that can affect the GDP of the country.

Agricultural Improvement by Groundwater

Food supply, a type of a personal consumption, is one of the main contributors to the GDP of the country. According to Gerbens-Leenes et al. (2010), the income of the people in the country, which is defined by the GDP of a county, is affected by the food consumption that are provided by the food stock in the market. For example, in 2020, food supply has been dramatically increasing because of consumers' concern for food availability in the COVID - 19 pandemic period (Hobbs, 2020). However, there are other aspects that can affect the production of food and affect the GDP of the country.

Agricultural products can affect the food supply and the GDP of the country. Agriculture is how most raw foods are produced in such as fruits and vegetables. As the agricultural production increases, the food supply increases too, and the GDP of a country grows. Multiple factors can increase agricultural production. However, irrigation is the most important essence for agricultural products. Since farmers aim to increase the production of the crops, they should study the type of water used to irrigate plants.

Groundwater can be the best water for irrigation in the UAE. Al Blooshi et al. (2020) have conducted a study that support such a claim. The main objective of the study is to investigate the climate change effect on both agriculture and groundwater. In addition, Al Blooshi et al. were able to analyze and study other aspects, including the relationship between groundwater and agriculture. The experiment was conducted in Abu Dhabi (87% of the country's land), Alain, and Al Dhafra. The article mentions multiple studies conducted by the authors. For example, a survey conducted by the authors on farmers to investigate how groundwater is responsible for agriculture fluctuations. The survey illustrates that 68% of Al Ain farmers agreed on improving Alain's agricultural outcomes because of groundwater usage. As agricultural production increases, more products will be available to the consumers to buy, and the GDP of the country will increase.

Environmental Crises and Groundwater Extraction

Some experts found that groundwater extraction can cause multiple environmental crises. Plummer et al. (2016) explains that pumping groundwater can cause damage in the aquifer, which is the area where groundwater is located. Plummer et al. clarify that over extraction of water from the aquifer can cause aquifer depletion. The aquifer depletion can cause cone depletion, which is a conic shape of the aquifer. This conic depletion can cause the land to fall. The sinking of the ground surface is called land subsidence. In addition, Erban et al. (2014) has studied the relationship between groundwater extraction and land subsidence. As a result, the author considers that the main source of land subsidence is the groundwater extraction.

Erban et al. (2014) also indicates that land subsidence causes other environmental crises. For example, if land subsidence occurs, the land of the country will become submerged. To elucidate, the sea level is stable. Simultaneously, the land subsidence results in the land level being below the sea level. Therefore, seawater will overflow and drown the land either partially or entirely.

Groundwater Evaporation by Climate Change

Specialists may think that providing groundwater to the public can be problematic because of its limitation. Since groundwater is finite, extracting groundwater will cause underground depletion, which means the ground will dry up and the water will drain. However, this depletion can be prevented by recharging groundwater, which is refilling the groundwater. Indeed, the groundwater can be recharged naturally without human effort.

Although groundwater can be recharged naturally, the environment can disrupt the recharging process. For example, Mohammed (2018), a professor at the United Arab Emirates University, has conducted an experiment that examines the relationship between climate change and recharging groundwater. The article is based on a study conducted by the author in the Abu Dhabi, which represents the UAE since it has more than half of the country's land. The result of this experiment shows that global warming increases the air temperature and causes evaporation, so less water will be available to recharge the

groundwater. Since an increase in climate temperature contributes to the reduction of recharging groundwater, less groundwater will be available. Therefore, groundwater cannot guarantee enough drinking water for the public.

Groundwater Extraction Prevents Floods

Although groundwater pumping can cause harm to the environment, proper management of groundwater usage can prevent some of the environmental traumas. Floods can be one of the examples of environmental traumas that could be prevented by groundwater extraction. To elucidate, both groundwater extraction and high-rate precipitation have disadvantageous for the citizens. Extracting groundwater will cause aquifer depletion, and a high rate of precipitation can cause floods. However, if groundwater extraction and high precipitation rate were in the same system, they can both be converted into a valuable service to the country. This advantage can be accomplished by recharging groundwater from the rainwater.

Multiple studies illustrate the relationship between recharging groundwater and precipitation. For example, according to Jasechko et al. (2014), the main source for recharging the groundwater is precipitation. Jasechko et al. have studied the relationship between the groundwater refill and the seasons with different precipitation rates to support their claim. The authors discovered that when the amount of rainfall is high, the amount of recharge groundwater also increases. As such, groundwater and precipitation can work simultaneously to balance the amount of water. The rainwater can prevent groundwater depletion, and groundwater extraction can have more space for rainwater to flow from the planet's surface to the ground and prevent floods.

Although groundwater extraction can resist floods, some experts think that the UAE does not have high enough a rate of precipitation to risk flooding. For example, Shanableh et al. (2018) has examined the average rainfall in Sharjah, and it was only 100 millimeters per year. Therefore, he discovered that the UAE has little chance of experiencing any floods.

Despite the UAE not having high rate of precipitation, the recent changes on the Earth have increased the possibility of flood occurrence in the future. Mohammed (2018) has found that UAE is experiencing global warming along with the other countries. In addition, according to Trenberth (2011), global warming has dramatically increased the precipitation concentration rate. This increase in temperature has raised the risk of flood occurrence across the nations. To clarify, the effect of global warming on the temperature has caused significant fluctuation in the hydrological cycle. Hydrological cycle is the fluid transmission in sequence from the land, water body, atmosphere, and finally in precipitation form. Since the precipitation is formed from the fluid in the atmosphere, atmospheric temperature can be one of the factors that affect the precipitation. According to Trenberth, for every 1°C, 7% of the precipitation will increase. Since global warming increased the temperature of the Earth, water from the ground will evaporate into the air. Some experts, such as Mohammed, think that it will eliminate the recharging water only. However, Trenberth has furthered analyzed the study of water evaporation. Trenberth discovered that the hydrological process would transmit the evaporated water into the clouds and convert the evaporated water into rainwater. Consequently, the precipitation, specifically the rainwater, will increase and will be denser, and rainfall will be increasing across the nations. The UAE can be one of the countries that encounter this global warming effect on the precipitation rate, and there is a possibility that the UAE may experience a flood.

Governmental Solutions

The governments of the UAE have taken actions to prevent environmental damages associated with groundwater extraction. For example, Dubai Municipality (2020), a governmental agency responsible for the overall quality of Dubai's environment, publishes a guide for groundwater extraction. The guide’s objective is to explain how the public and institutions should use groundwater in Dubai. The guide is published annually because groundwater condition may change, depending on the groundwater condition and the country's environment, and the direction of groundwater usage may change with groundwater

and environmental changes. In this paper, I have used the 2020 edition to explain the recent Dubai Municipality's groundwater management.

This guide is mainly about the institution's mission to save groundwater in Dubai and groundwater protected areas (GPAs). First, the guide introduces the audience on how groundwater is extracted in Dubai and where it is mainly used. Second, the article mentions some of the laws in the UAE imposed on whoever disturbs the plan of protecting the groundwater. Third, the article points out the designated areas of backup water supply in the country by providing the locations of fresh groundwater in Dubai. These areas are prohibited from practicing by the public unless they have permission from the municipality. Finally, the article mentions guidelines on how groundwater should be extracted to prevent any contamination of groundwater loss.

The guide mentions some of the laws that can prevent any external disturbance to their projects. For example, local law no. 15 (2008) has mentioned that the Dubai municipality, specifically the environmental department, is responsible for groundwater safety. They are the only institution that can allow or reject the public's request to use Dubai's groundwater. Therefore, the municipality is seen as the most suitable institution that can develop projects that conserve groundwater. In addition, any disturbance to any project may cause the person to be prosecuted.

Solution to Groundwater Limitation

Although groundwater is finite, there are actions practiced by the Dubai Municipality to prevent groundwater depletion. For example, the municipality has located the areas with fresh groundwater, and these areas are called groundwater protected areas (GPAs). GPAs are the areas that have been tested by the municipality, and they approve that the groundwater in the area are drinkable and to functional for agricultural purposes and industries. The measures used to assess groundwater safety include studies of groundwater quality, flow, and contamination possibilities. The GPAs areas are split into two categories, the inner protection zone (Zone A) and the intermediate protection zone (Zone B). Although each zone consists of

a distinct program, this paper is interested in Zone A since it has a suitable program for safe drinking groundwater. In addition, after these locations are approved to be GPAs, any practices surrounding the area should be approved by the municipality.

In addition to the designation of GPAs, the municipality adopted the artificial recharge study to save groundwater from depletion. Artificial Recharge is a process of human intervention to fill up groundwater in the aquifer. Some of the developed countries have successfully managed artificial recharging projects. A developed country is a country that is stated to be highly progressive in the economy, technology, and human development (Investopedia, 2021). Some of the cities in the developed countries that implemented artificial recharging projects are Winchester in the United Kingdom and Shanghai in China (Investopedia, 2021; Zheng et al., 2018). In addition, according to the municipality, the artificial recharge project can also make the groundwater more suitable for consumption. The project can recharge salt-free water groundwater, which is the water that people usually drink.

Solution to Land Subsidies

Since groundwater pumping can cause land subsidies, there should be an institution that can control groundwater usage. Therefore, in Dubai, the Dubai Municipality has defined the GPAs to monitor the citizens and other institutions' usage of groundwater to eliminate the extraction process effect on the environment.

Although the approval for using GPAs is from the Dubai municipality, the municipality should consult with the natural resource conservation service (NRCS) before approving any request of GPAs usage. NRCS is an international agency that assists landowners in managing the use of their lands. NRCS decision is based on studies that analyses the extraction process effect on both the land of the UAE and the surface of the globe. Therefore, the municipality consults NRCS to ensure the safety of groundwater usage.

Conclusion

Using groundwater as a drinking resource could be the best option in the UAE. This alternative is crucial because it has various benefits for people's health. For instance, the UAE's groundwater may contain healthy minerals, such as magnesium, to cure heart disease. Groundwater can also be advantageous to the UAE's environment, such as preventing floods. Finally, the groundwater can increase the personal consumption of agricultural products in the country, the GDP of the country, and the rate of economic growth.

Although groundwater can benefit UAE citizens, there are some challenges to support the usage of groundwater. First, groundwater extraction could cause severe consequences to the environment, such as land subsidence. However, this ecological crisis can be prevented by managing how people extract groundwater. Indeed, in the UAE, governmental institutions consult international institutions before any actions. Further, groundwater is limited. Despite groundwater limitations, governmental institutions, such as Dubai Municipality, have set rules for the community, and they have multiple projects that help prevent water depletion.

Markets in the UAE have numerous drinking water options from various water brands. However, consumers may think that all of them are identical. Consequently, they may buy any water randomly. In reality, the water quality differs between water brands. This difference is because each company has a unique method to provide water to consumers, and one of the main differences is the water resource. Since the water quality depends on the water's resource, the consumers should now the origin of their drinking water. Since more than half percent of humans body is a water, consumers should wisely choose their drinking water to stay hydrated and healthy.

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