

Dissertation

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University of Central Lancashire

# Drinking in Oman: Literature Review



Hebert E, (2009)

Stender H, (2011)

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**Course:** BSc Hons Health, Safety and Environment Management

**Academic Year:** 2013-2014

**Dissertation Supervisor:** Michael Clark

## **Declaration**

“I declare that the main text of this dissertation is no more than 10,000 words, and is all my own work”

**Signature: Mashaal Al-Farsi**

**Date: 25/6/2014**

## Abstract

Bottled water defined as drinking water packaged in different sizes and shape of plastic or glass bottles produced from several water resources such as well, distilled, mineral or spring water, it may have get some chemical or physical treatment in order to be useable for domestic demand. However, recently the use and sale of bottled water have risen rapidly and the demand is increasing significantly which may have negatively affects on human health due to chemical substance leaches into filled water. As well plastic bottles may create some environment impact result of plastic waste.

Many people prefer bottled water instead of tap water and that may increase day by day which perhaps help to rise up this industry production. Many studies (Doria F, (2006) and (epa.gov, (2005)) have shown that bottled water consumers believe that water in bottles is more convenient, safer and has better taste with good quality than tap water.

The dissertation scope on Bottled Water Industry in Oman and going to covers bottled water production and consumption in the country including its health and safety adverse effect on human and environment surrounding. Here the study identified and evaluated some information associated with why Omani people are prefer consume bottled water over than other types. As well the project involves some important objective related to bottled water management in the country and determines the current state of its plastic waste system.

In addition, the dissertation takes into account the plastic materials that are used in bottled water manufacturing, as it involve general and specific questionnaire to public and authorities bodies to stimulate their understanding on bottled water case. Many sources used to collect the topic information like literature reviews, questionnaire survey, interviews with authority bodies, public, websites, newspapers and some regulations. Some information analyzed by graphical techniques.

## **ACKNOWLEDGEMENTS**

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**Date:**

**To: ministry of regional municipalities, Environment and water resources**

**Ministry of environment and climate affairs**

**Ministry of commerce and industrial**

**Address: Sultanate of Oman, AL-kuwair**

**First of all I am grateful to Mr: Michael Clark the teacher of Disaster response and management module and Miss: Hannah Neate the teacher of dissertation, whose gives me chance to do this work.**

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**Miss: Mashaal Alfarsi**

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## **ABBREVIATION**

**GCC: Gulf Countries Council**

**IBWA: International Bottled Water Association**

**EU: Europe Union**

**UAE: United Arab Emirates**

**WWF: World Wildlife Found**

**PET: polyethylene terephthalate**

**UK: United Kingdom**

**VOCs: Volatile organic compounds**

**THNs: Trihalomethanes**

**NRDC: National Resources Defense Council**

**U.S.: United State**

**NAPCOR: National Association for PET Container Resources**

**WHO: World Health Organization**

**ISO: International Organization for Standardization**

**MOECA: Ministry of Environment and Climate Affairs**

**MOCI: Ministry of Commerce and Industry**

**MRMWR: Ministry of Regional Municipalities and Water Resources**

**MOMP: Ministry of Manpower**

**ICEM: International College of Engineering and Management**

**UCLAN: University of Central Lancashire**

**Baiza: the currency of Oman (1 £ equal 650 baiza)**

# chapter no: 1

Water consider as one of the renewable source which is an essential element of earth life and humanity (called by liquid gold). The high demand on water and water resource is increasing continually due to human activities and other sectors.

People required around 150 to 300 litres of water daily for domestic purpose (Siddiqui N (2008)). As well as 97% of the world water is salty unusable for domestic consumption and 1% only of global water is available for human consumption. At present time, some Arab countries suffer from limited fresh and clean water resource and that create real threaten to livelihood. Availability of surface water is declining each year result of over pumping of groundwater, shortage of rainfall, increasing in population and urbanization development (World Bank, (2009)). Oman one of these countries and studies shown that there is acute shortage of over 300 cubic million meters of water each year (Sue Hutten, 2003). However, result of absence of clean and safe drinking water, bottled water industries has appeared as a good alternative solution around the world.

Additional to freshwater shortage there are also some other factors lead to increase consuming bottled water in Oman including change in life style, urbanization development, increasing population and unwanted taste, smell of municipal water. So, all that made bottled water is seen as first choice of drinking water. Therefore, bottled water productions are developing widely in the country and it seems become as permanent fixture in million hands of resident.

The revolution of bottled water development might create additional pollution problems to environment such as increase plastic waste volume, manufacturing, transporting and recycling cost, fuel, oil and energy consumption including to its toxic gas emissions, excessive ground, surface water exhaustion and soil degradation. Beside that, permanent drink bottled water may contribute to some human health illness result of leaching some toxic substance of plastic bottles into filled water causing serious disease such as cancer, tumour, kidney problem and gastro disturbance.

## **Aims and objective**

Under research project highlighted a critical study of using bottled water in Oman and try to produce some understanding outcome related to recent excessive consuming of bottled water. In addition the project involves some public and ministries government questionnaires methodology. Thus study might help to display some suitable solution for bottled water issue in Oman.

The dissertation discusses, investigate and achieve the following objectives

- ✿ Estimate the consumption and production amount of bottled water that used in Oman
- ✿ Identify the source of water that used in bottled water and manufacturing process.
- ✿ Search behind reasons that made Omani people prefer using bottled water and their opinion on municipal tap water
- ✿ Identify and evaluate the negative and positive human and environment health impacts
- ✿ Discover the government standards and regulations associated with bottled water industry.
- ✿ Provide some recommendations to government authority and bottled water consumers.

# chapter no: 2

## **Literature review**

Water consider as one of the renewable source which is an essential element of earth life and humanity. There is high demand on water and water resources and that increasing day by day due to fast increasing in population, shortage of freshwater recourse, excessive using of water in industrial and agriculture sectors and domestic propose (Hope R and

Staat M (2006), Enger E and Smith F (2008)). In point of example people required 150 to 300 litres of water daily for domestic propose involve drinking, cooking, and washing (Siddiqui N, 2008). Thus reasons make the conservation of freshwater resources an important management issue in business and society. However, invention of bottled water has might become as a super alternative of freshwater resource instead of natural source which has spread widely around the world and it would quickly become reachable and fixture in the billion hands (Griffin S, (2009). Through attractive labels and beautiful advertisement bottled water becomes a successful business due to increase selling and consuming among public. Also that leads to raise competition between bottled water companies to produce more quantity and improve their manufacturing quality. But the question will remain is bottled water healthy water or markets want people to believe that (Ferrier C, (2001).

Bottled water defines as clean drinking water filled in different size and shape of plastic or glasses bottles which sometime required chemical or physical treatment to be ready for selling and domestic uses (MNN, (2013)).

The (IBWA) and (EU) specified bottled water in three types according to the source and that include natural mineral water is pure water produce from underground and contain stable level of minerals and trace substance which is protected from contamination hazards. Second type spring water is also underground water flows naturally to the surface. It is free from bacteria, consist from unstable mineral composition and usable for drink. Third type is Purified water that is collected from different water resources including rivers, underground water, lakes and municipal tap water which may have several physical and chemical treatment processes such as distillation, reverse osmosis or adding different mineral components in order to make it suitable for use (Ferrier C, (2001) and Gleick p and Cooley H, (2009)).

The total renewable water resources are estimated about 40,000 bcm but the lowest amount is in Arab world reaching  $636 \text{ m}^3$  per capita. The leak of fresh water recognized a serious global concern due to several factors including drought condition, climate change, geographical locations of countries, fast increasing in population, shortage of fresh water resources and excessive using water in industrial and agriculture sectors (Hamoda M, (2004) and Al-Zubari W,(1998))

According to United Nations mention that most GCC countries fall in the category of acute water shortage which has annual rain water capacity less than 500 cubic meters per capita and annual surface water are around 3, 33 million cubic meters ((Haddadin M, (2002) and Raouf M, (2010)).

The global bottled water consumption is estimated to have a crossed 53.9 billion gallons in 2009 which is accounted for more than 29% of total volume of liquid refreshment beverages. The worlds bottled water industry in 2010 recorded increasing rate of 4% to exceed 99 billion and the market had a volume in excess of 152 billion liters for cost reached to 183 billion liters (MANSOOR N, (2011) and (Arnold E, (2006) 2).

In 2003 the volume investment of bottled water in GCC reach to 444 million dollar and that only in 106 bottled water factories which have a number of employees about 9900 person. Saudi Arabia conceder the biggest country in GCC producing bottled water which has more than 60 factories then UAE comes in second level with 25 factories (Ahmed M, (2004)).

Uromonitor International has been reported that the bottled water market is exploding across the GCC or an unprecedented scale and the consumption of bottled water has increased more than a third over the past five years. Saudi Arabia alone consumes 133,4 million litter of bottled water which may increase to 1998,7 million litter by 2015. Almost some consumption in UAE which is shout up from 514,5 million litter to 768,1 million litter (Hotelier Middle East Staff, (2011)).

Dr Abdullah All-Hinai acting director general industry in Oman (MOCI) mention that the total water used in the country is estimated to be 1,5 billion cubic meters last year's which may increase to 1,7 billion cubic meters by 2020 (Blog Z, (2012)). As well as the total production of bottled water in the co<sup>5</sup>ntry estimated around 402 million m<sup>3</sup> litter in 2010 and more than 54 million m<sup>3</sup> litter is imported while the exported volume of bottled water reach to 14 million m<sup>3</sup> litters (Alwatan Internet Department, (2003))

Recently UAE recognized and being the third highest country in the world in bottled water consumption followed by Saudi Arabia and Qatar which ranked in 13<sup>th</sup> and 16<sup>th</sup> respectively with 26,4 and 25,5 gallons per capita consumption of bottled water in 2009 (MANSOOR N, (2011)).

Now day many of GCC countries such as UAE and Saudi Arabia have taken serious steps in bottled water situation and announced the band on export bottled water. The decision on band is based on the recommendation of the federal national council on water resources and bottled water. However, the decision aims at promoting water security in the country and for the protection of groundwater resources from depletion (Zafar M, (2012)).

According to water research centre of king Abdulaziz University in Saudi Arabia that Saudi Arabia conceder the biggest country in the Middle East in producing bottled water which has 15 factories in 1994 and that number increase to 60 factory in 2004 with total capacity of 2, 3 billion liter per year (Zahed W, (2005)). And WWF in 2001 mentions that the average individual consuming of bottled water around the world about 89 billion liters every year (Klessing L, (2004)). Another study done by US.NRDC in 1999 was shown that more than half American civilian drinks bottled water regularly in percentage of 33% (Olson E, (1999)). Aslam, A., (2006) state that consumption of bottled water in 1999 has increased from 98 billion liters and reaches to 154 billion liters in 2004 around the world.

Earth Policy Institute mentions that in 1976 around 1.6 gallons of bottled water drank by American people and this number has been doubled to 30 gallons later after 30 year per person. It estimated that bottled water cost higher than tap water around 240-10,000 times in the world Didier S, (2014).

The different sizes and shapes of bottles water which made of PET plastic substance has rapidly grow up in the markets and become as permanent fresh water source for millions people reach to 15 million tons in 2007 (Griffin S, (2009)). Besides that, 66 liters of bottled

water per capita is drunk by Canadians only and more than tripled that number is imported from out the country (Griffin S, (2009)).

As well as between 2000 and 2006 demands of bottled water has increased rapidly in UK and consuming shoot up from 1415 to 2275 million liters (Ward L, Cain O et al, (2009)).

people consuming various types of bottled water for many reasons include thought bottled water have good quality more than tap water because it is pass through better advance of treatment and it doesn't expose to contamination which is controlled by Food and Drugs Administration. As well due to some health reasons (Doria F, (2006)). Another reason people prefer and like taste and smell of bottled water because tap water sometime may be disinfected or treated with chlorine which often has unwanted smell and taste is unpleasant (epa.gov, (2005) and Paolo J, (2014)). Beside that due to urbanization development some group of people consider using bottled water as one type of fashion in lifestyle (Arnold E, (2012)).

According to the result of Canadian survey which done to Saskatchewan citizen conclude that most people selecting bottled water as their primary drinking source due to complex multiple reasons including thought tap water is not safe, un health to drink, fear of contamination, home is not in city and tap water services is not available (McLeod L et all).

The World Health Organization reports that more than 1.4 billion people lack access to safe drinking water and 80% of human illness results from insufficient water supplies and poor water quality. According United Nations Environment program estimated that 5 million to 10 million deaths occurs each <sup>7</sup> year because freshwater is contaminated Hope R and Staat M (2006), Enger E and Smith F (2008). Several advantage of bottled water drives people to used including easy to obtained, available everywhere, light weight to carry, water proof and corrosion resistance (Westerhoff P et al (2008)) and Ferrier C, (2001).

Bottled water might play important roles in critical disaster or emergency situation (war, Hurricane, earthquake, etc). In some world countries found difficult access to clean water so bottled water could help to cover part of water shortage in such cases. Also it often use as temporary source if freshwater is contaminated (MNN 2, (2013)).

It is seem bottled water manufactories widely depend on some chemicals materials called polyethylene terephthalate (PET) that plastic used to form water bottles by several technology processes. The PET plastic is light weight, easy to transport, very convenient for most people and required less amount of energy in order to form other types like cans or glass. Also the PET plastic bottles water is recyclable 100% and it is the most extremely recycled in the national curbside recycling programs (IBWA), (2014).

On study done at university of Helder berage in 2007 found the bottled water that made from PET plastic may leaches metal antimony substance into water during filling process which become more toxic when water remains in the bottles for long time or when filled water contaminated or inhaled by high concentrations of dusts that might cause some gastrointestinal problems, vomiting or lose motion (Griffin S, (2009)).

Another study mention that plastic compose the bottles maybe potential to release some toxic substances by helps of climate condition especially at high temperature causing contamination to filled water. A high temperature might increase antimony leaching from bottles into water. The using of bottled water that had long exposures to high temperature might increase blood cholesterol and decrease sugar level in the human body (Westerhoff, P et al (2008)).

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According to some studies state that (VOCs) and (THNs) may present in bottled water during the process of chemical treatment, accidental contaminations or may be by leaching during packing materials. Thus substances if it is found in high concentration in water may cause serious health impacts including risk of bladder, stomach rectal cancer and reproductive problems (Ikem A, (2010)).

Another study indicate that some natural mineral water contain some microorganism and that bottled mineral water may not free from bacteria which may lead to transmit this

bacteria to human system potential to create disease especially in people have weak Immune System (Falcone-Dias M, (2012)).

Also, There are studies has done by NRDC found that most of the bottled water which has been tested and examined around 22% of them contained some contaminates exceeded the level of health limits. So, contamination could be present in the bottled water which stored over 10 weeks such as hormone disrupting phthalates Didier S, (2014).

Many of bottled water characterized by major and trace inorganic components which significantly different in concentrations such as  $\text{Ca-HCO}_3$ ,  $\text{Ca}$ ,  $\text{SO}_4$ ,  $\text{Na-CHCO}_3$ . These elements are added to water in order to maintain taste, smell, appearance and to give bottled water some health nutrition values but thus chemical elements may turned to poisons if present in high concentration levels or it exceed the international guideline causing some adverse effects on health. For example present of “Na” in high concentration in bottled water and customer use it regularly it might increase the blood pressure or may effects the body ability to regulate fluid balance. A hardness “ $\text{CaCO}_3$ ” of some bottled water may create some risk to patient who complains of kidney problems (Varrica, D at all (2013) &Colltte C, (2014))

The bottled water industry has several procedures involve manufacturing the bottles, treating the water, filling, labelling and transporting them to markets. These processes required high quantities of fossil fuel and consume vast energy which may contribute to raise the environment and public health concern regarding air pollution and plastic waste. The burning of huge amount of fuel in bottled water might lead to increase greenhouse gases, rise atmosphere temperature or release some other corrosive toxic gases due to transportation process (Griffin S, (2009), Arnold E, (2012) and Ferrier C, (2001))).

One study shown that Americans people drink bottled water around 29 billion every year, therefore to produce this large number of bottles required a huge amount of crude oil

around 17 million annually. This amount of oil and fuel is enough to keep over 1 millions of cars and vehicles for around 12 months in the road [Didier S, \(2014\)](#).

In India the total usage of bottled water is estimated around 14 billion litres per year which still growth continually around 25%. The consumption of bottled water was increase three times in 2004. There are more than 200 brand of bottled water available in the country at the present time. According to one assessment was done for eight bottled water industries in India indicate that this industry consume and required high demand of energy which involve [Tandon S et all, \(2014\)](#)):

1. PET resins formation (77 MJ per kg for virgin PET)
2. Fraction performs (required 20 MJ per kg)
3. Sand filtration, Ozonation, RO and bolting process (energy consumption are range from 0.009 MJ to 0.02 MJ per litre)
4. Packaging material ( one carton of bottled water production required 4.5 MJ and energy)
5. Transportation (energy requirement approximately 100 MJ (depend on distance of traveling))
6. Collection and recycling

A study was done in 2009 to measures the energy used and pollutions emission from PET, glass and aluminium containers of soft drink found that PET containers and bottles were consume less amount of energy and release less emission of greenhouse gases and solid waste from other types of containers [\(CRI\), \(nd\)](#).

The working process of manufacturing bottled water itself involves many of chemical hazards that may potentially affect workers in the factory. For example antimony trioxide is used in catalyst to make PET and ethylene glycol which might cause human carcinogen and kindly toxicant. Also some water borne substances and toxic gases like benzene, methylen chloride and ethyl benzene which are listed are reproductive toxins by international Agency for Research on Cancer [\(Griffin S, \(2009\)\)](#).

Besides that, bottled water result in high number of plastic waste and required extra financial cost to be recycled or reused, as well in some poor countries it maybe remain as garbage disposed in landfill or sent to incineration which might generate some air pollutants [\(Arnold E, \(2006\) 2 and Ferrier C, \(2001\)](#).

plastic production have grown rapidly to be popular material used in worldwide because it is cheap and it can serve for long time and most plastic production are made of polyethylene. This substance used in bottled water may have dangerous effect on environment and people health and that because plastic is non biodegradable material which could combined to create toxic chemical reaction additional to pollutants solid (Charles, T. (2007)&Rita,P. (2010)).

Only around 13% of 29 billion of bottles water which has been drunk by Americans send to recycling and produce from them some products such as carpeting, new bottles and containers, playground equipment and clothing while in 2005 around 2 million tons of bottles water end up in landfills in the U.S. estimated by National Resources Defense Council Didier S, (2014).

(NAPCOR) stated that in 2011 92% of 5,478 million pounds of waste plastic bottles that made from PET end up for recycling and around 242 million pounds of them only were reused for beverage and food containers (CRI), (nd).

However, the benefit of recycling system include: conservation of raw material, maintaining of crude oil, and reducing gas emission of generating new material, addition to decrease the landfill and incineration area that could save around 6.7 cubic meters of space and saving energy. Some studies show that in recycling one pound of PET could conserve approximately 12,000 British Thermal Units (Harrison P, (2014)).

The recent research found the recycling of single plastic bottles can save energy enough to light a bulb of 60 watt (IBWA), (2014).

The authors' (Varrica D et al (2013)), Ferrier C, (2001) mentions that the bottled water is not better or healthy more than tap water and the selection of using tap water may have benefits including reduction of waste plastic, decreased consumption of oil and energy and reduce greenhouses emissions. So, tap water may contribute in economic saving due to reduce spending a lot of money to buy bottled waters or produced.

The consumption rate of bottled water is more in Western countries around 120 litres per person while approximately 20 litres per person in Asia and lowest consumption was in

Africa estimated to be 10 litres per person. Some companies start using some clever strategies and work under social responsibility profile for example Volvic bottled water company emerged in partnership with UNICEF which develop offer that buy 1 litre of mineral and the company would provide 10 liters of drinking water to Ethiopia famine and African countries (Brei V et all, (2014)).

Media report, actor advertisement, campaigns awareness, brand image and marketing practice of bottled water have associated with the success of transform bottled water into consumer activities and thus programs contribute successfully to increase sealing and consumption of bottled water around the world (Brei V et all, (2014)).

# chapter no: 3

## **METHODOLOGY**

The area of bottled water research was Oman. To carry out research there is need to collect data from different resources which include visiting different sectors related to the topic like Ministry of Regional Municipalities and some bottled water companies additional to people interview, data gathering from web sites and newspaper.

### **3.1 Data collection:**

The research was holding various data collection methods to achieve the objective of the research. Site visit was carried to the **MRMWR** in Muscat to make interviews with **Deputy Director of well permitting department and Senior hydro-geologist, Assistance Director Water resources development department**. The interview was designed to collect information about the strategies and plans that government applied for bottled water and water demands management. In addition to record the main water resource in Oman besides to bottled water source.

Another visited was to the **MOECA** to have interviews with responsible persons to write and analyse the human health and environment impact of consuming bottled water in Oman. The visit was aim to know the actions that the ministry implemented for reducing the impacts of bottled water like look at the regulations and methods of reducing the negative effects. The meeting was with **Director of planning and studies and Environmental inspector**.

There was also interview with staff working in Oasis bottled Water Company, was done with **Manager- Quality Assurance** to know from where the bottled water comes, how it produced and how much they produce daily as well to estimate if there any impacts.

other visited to **MOCI** was carried with **Head of exemptions department** which goal to know how many bottled water factory in Oman and what their total production, as well to collect information about the source of water that used in bottled water and gather ideas about their regulations and standards.

The Questionnaire was prepared and distributed among the staff working in organizations such as the **MRMWR**, the **MOECA**, **MOCI** and Oasis Water Company. Firstly, take their approval beforehand. The questions included multiple choices and open questions allowed staffs write their suggestions. The questionnaire was asking about what kind of water they prefer and why. Also from where the bottled water comes from and is it safe more than tap water. As well as ask them about which beverage they prefer to use over water. Finally, ask them is bottled water has affects on human and environment or not.

Other questionnaire was distributed among general public such as teachers and students in (**ICEM**) in Oman and ( **UCLAN**) student in UK in order to know which water they prefer

and the reasons behind their choice also to discover how much they consume daily and which beverage they like over water. As well to evaluate their knowledge about bottled water side effects.

Secondary data was used to complete the research which provides basic and important data to complete the study. Collection information was from books, journals, previous studies, ministerial publications, newspapers and nongovernmental organization.

### **3.2 Data analysis:**

The collected data was analyzed by using Microsoft excel and manual analyzing. Microsoft excel was used to know percentages, sum. But for qualitative questions there was need to know people way of thinking, their prescription and their suggestion that might be used as solution for this problem.

### **3.3 Data presentation:**

The data was presented in different formats using charts and graphics to deliver the results which have been gained from collecting the data. In addition illustrating the data using this kind of figures, there was brief explanation of them to give clear picture regarding to the result and outcome.

### **3.4 Challenges**

Poor and weak responds was faced from 15 government ministries during data collection of dissertation because found some staff didn't answer the questionnaire in additional many of head department in charge apologize to have meeting and some time the information which given is not completed. Also some of them don't have much knowledge about bottled water industry activities. Approximately 200 questionnaire papers were distributed

to staff and head department managers. Unfortunately, less than 90 papers were answered and some answers not completed as well the rest of papers were not sent back. From other side, 300 questionnaire papers were delivered between citizens in different area and 145 papers only replayed but 155 papers were not. Some people of both side (staff and public) didn't give much attention to the questionnaire and many of public mention that bottled water cannot create big environment pollution and it couldn't cause any health impacts because it is clean and safe. They said "why government doesn't band bottled water sealing and production if it cause that much of trouble?"

So, here from this question point discovered that there is poor education and public awareness toward bottled water impacts.

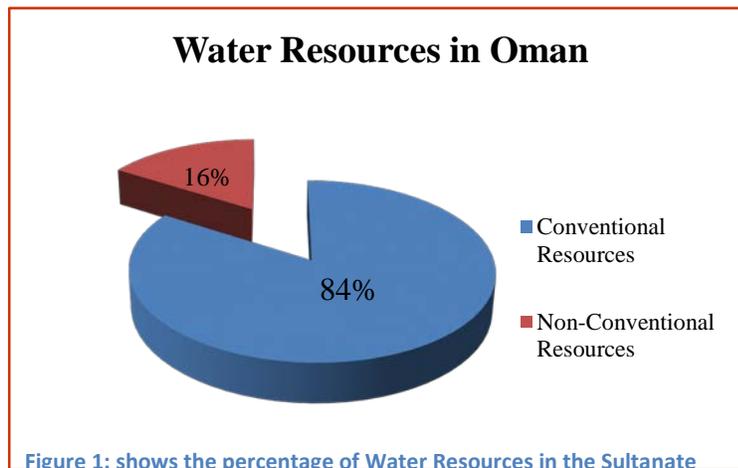
However, another challenge was the far away distance, the travelling from my city to the capital was very difficult because should travel more than 170 km to have meeting or interview with bottled water companies and other related sectors. As well as the weather condition was very bad high temperature and humidity beside the long time waiting hours, all that may cause some physical health problem. More than that, the travelling distance daily and waiting hours are contribute to wasting time. The shortages of information about plastic bottles recycling system in Oman create another challenge to dissertation project.

# chapter no:4

## Results

### 4.1 Water resources in Oman <sup>17</sup>

According (MRMEWR), (2005) water sources in Oman are two types: first, natural resources (conventional) resulting from rainfall, which presents on two main forms surface water and groundwater involve Aflajs, Valley, Dams, and Springs. The second type is non-natural sources (non-conventional) include desalination of sea and brackish water and treated wastewater. The natural water considered as the essential part of available water resources in Oman takes around 84%. The non-conventional source is around 16% from total water resources (appendix 2& (MRMEWR), (2005))



## 4.2 The source of water used in bottled water

Through interview and meeting with the ministries found that some bottled water factories are used groundwater by establishing and drilling wells to extract water from underground to be send to disinfections and filtrations processes in order to remove any contaminants which may then get some minerals elements are added, while other water plants use tap water which is the desalination water provided by the government. This type also passes through some process of treatment and filtration. However, from discussion discover that the first type is widely used in the country more than second type (appendix 2).

## 4.3 Bottled water industries in Oman

In the interview with MOCI and MRMEWR mention that rapid increasing in population, urbanization development and groundwater scarcity caused additional pressure on water

resource and lead to increase water demand therefore, bottled water industry present to cover the high demand on fresh water. Therefore, many bottled water industry has appeared in Oman and today there are around 22 companies producing different sizes and shapes of bottled water like 500 ml, 200 ml, 1.5 l, 5 l, 5 g etc which produce range from 316,000 l to 70,000,000 l of bottled water daily (appendix 2).

#### **4.4 Bottled water manufacturing process**

The below result and information are collected during visiting and meeting with Omani bottled water companies in Rusayl industrial city:

**Bottle Blowing:** PET resin is injection moulded into tiny test tube 'Preform'. These preforms are outsourced from various vendors located in UAE which move from the feeding hopper to the automatic orientated that conveys them into the rotary heating zone. Infra red lamps cover the entire zone traversed by the preform on their way to full development and are individually regulated in order to operate a differentiated lengthwise heating of the preforms themselves. This accurate process is meant to guarantee the best possible distribution of the temperature both along the entire length of each perform. At the heating oven outlet a sensor detects the preforms' temperature. During this process the system compares the detected data with the stored parameters and if necessary, re-modulates the infrared ray's lamps. Special grippers pick up the heated preform and position them in the stretch blowing stations. From the stretch blowing stations the bottles are picked up with special grippers and set in line for the filling operation or conveyed to a storage silo.

**Bottle Rinsing:** The Blown bottles are inverted and then subjected to Rinsing operation with the help of automatic rinser just prior to filling operation with Ozonated product water to eliminate any extraneous material and to kill any bacterial agents which the extraneous material can harbour.

**Filling:** The Product water with ozone is filled into the Rinsed Bottles with the help of automatic Filling machine which is also designed to ensure no manual contamination or handling during this operation.

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**Capping:** The Bottles thus filled are then capped immediately with the help of Automatic Capping machine and Tamper Proof Caps. Bottles were filled and capped through fully

atomised machines at a very high speed which completely rules out any possibility of any fungus developing in the bottle at the time of filling and capping.

**Coding:** the filled and capped bottles are conveyed through coding stations where coding is done on the Solder part of the bottle for date and time of Production and expiry. This operation is in line with the product traceability program.

**Filled bottle Inspection:** Coded bottles are then conveyed to the filled inspection station. Bottles which are high or low filled or uncapped or un-coded are rejected at this stage.

**Labelling:** The Bottles labelled with the help of automatic labeller machine which wraps the Labels around the Bottles and glues it to fix the labels onto the bottle.

**Casing:** the Products are put in Cartons or made Shrink wrapping and Palletized for Shipping and Distribution. The Carton erecting followed by sealing or Shrink wrapping operation is automatic operations

**Product Release:** The Products are tested for fitness for consumption and then distributed for consumption.

## **4.5 People choice which water to drink**

As known it is impossible to survive without drink water more than few days. Overall, in Oman there are multiple systems of supplying drinking water such as: (1) bottled water is clean drinking water filled in different size and shape of plastic or glasses bottles. (2) Tap water is clean water provided by the municipality in pipes networks. (3) The Filtered water

is a tap water provided with some devices of filters in order to remove contaminations ((IBWA2), (2014)).

Through the survey results of staff and general public questionnaire seem a lot of people in Oman prefer drink bottled water rather than other types. The survey findings show that: 15% of general public and 9% of employed people prefer the filtered water while 31% of general public and 42% of staff are consuming bottled water. The tap water user are very less because 4% of general public and 3% of staff only are use it, see figure 2 (appendix 1)

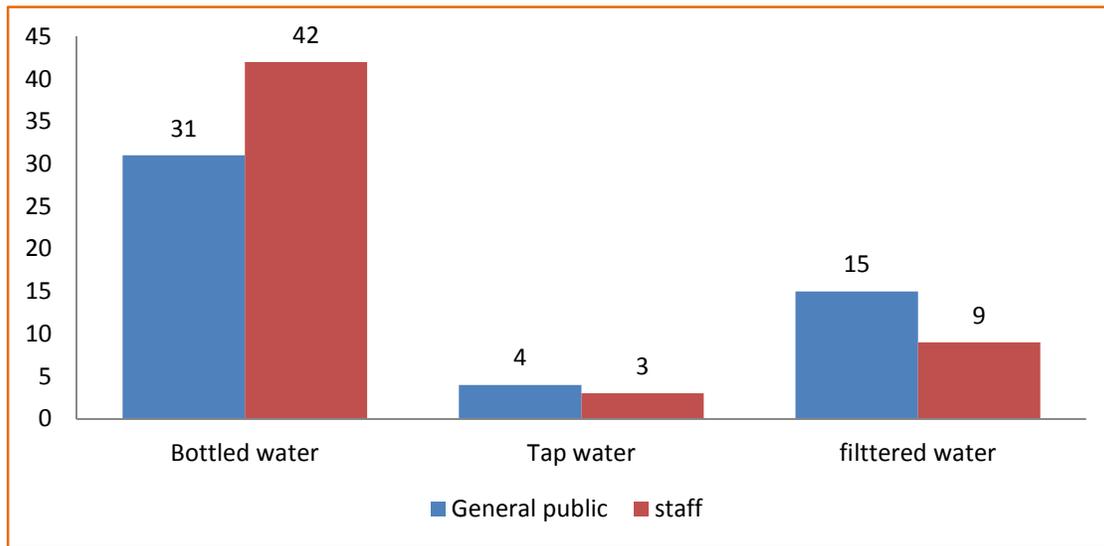


Figure 2: which type of water they prefer?

People drinks water all the time and the demand on water are increased day by day. Anyway, people have right to choice which type of water they like to drink and that depend on the state of person requirement in<sup>21</sup>addition it depend in how much volume of water consume per day of each water type. The survey analyse state that around 28% of public and 33% of staff are drink1-3 bottles daily. While other group drink 4-8 bottles in the percentage 17% by staff and 16% by public. As well another group consume 8 and more bottles daily that estimated to be approximately 6% of general public (appendix 1), see figure 3.

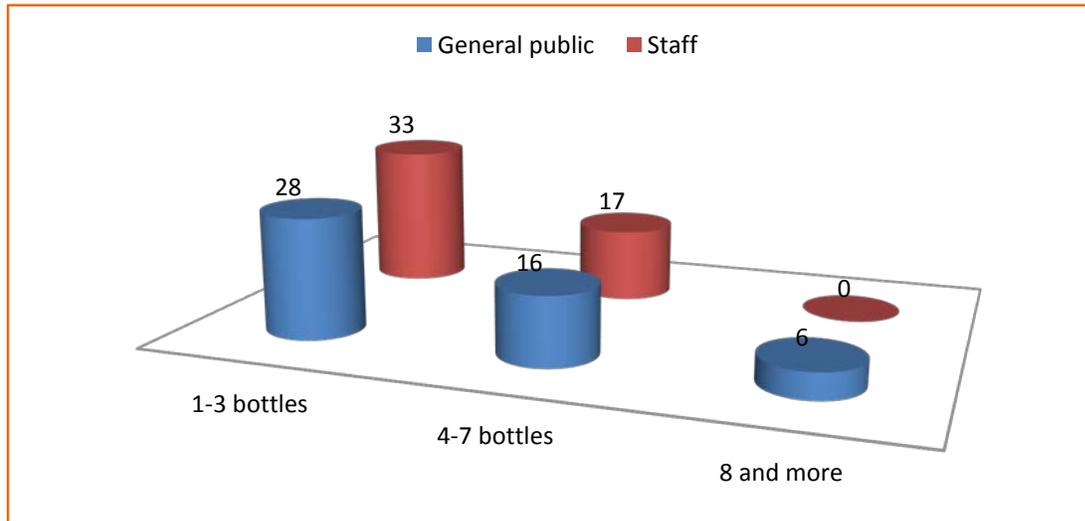


Figure 3: How much they consume daily?

In general freshwater is essential element for human being which almost interferes in all people activities such as cooking, cleaning, drinking, washing etc. From survey data discovered that there are some drinking beverages are used over their prefer drinking water such as tea, coffee, juice, soft drink, wine and bear. around 27% of staff prefer to drinks tea and coffee over the water and approximately 25% prefer juice figure 4. From other hand, 25% public prefer soft drinks over water while 18% of them prefer juice with water.

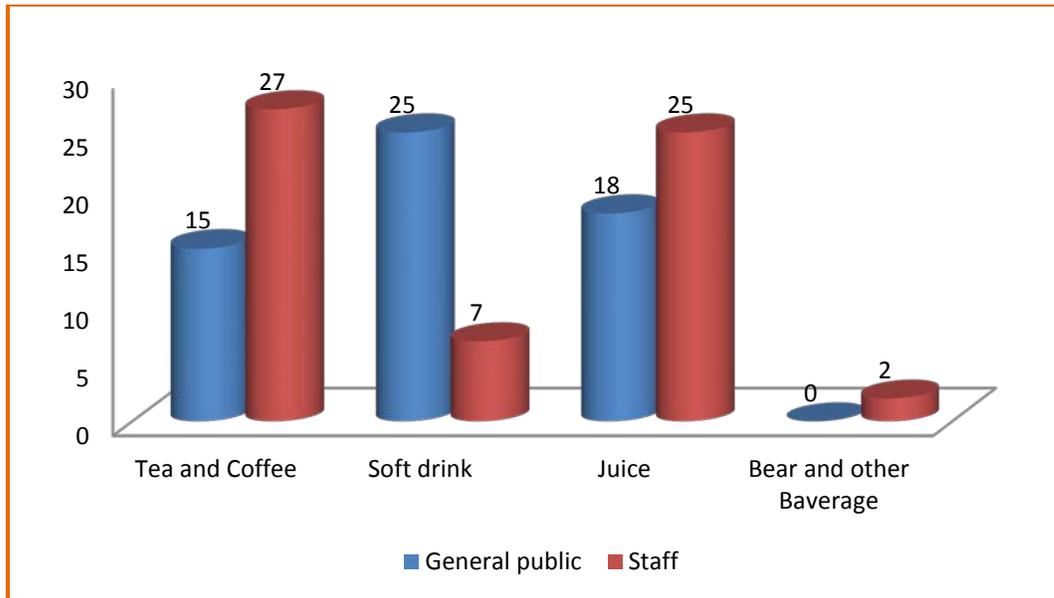


Figure 4: which type of beverage they prefer over water?

#### 4.6 Reasons of using bottled water in Oman

There are several reasons and causes present in the survey explained why Omani citizen consume much of bottled water production. Around 66% of people especially workers said that the bottled water is safer than tap water as shown in figure 5 (appendix 1).

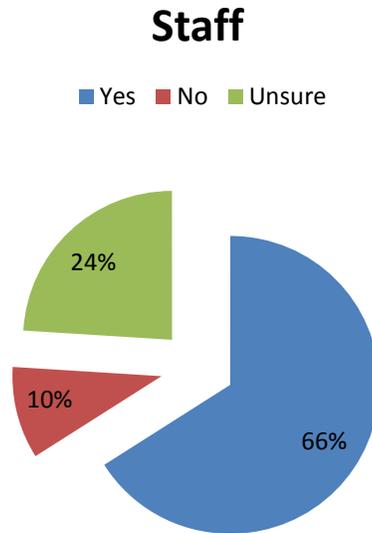


Figure 5: Is the

The other re

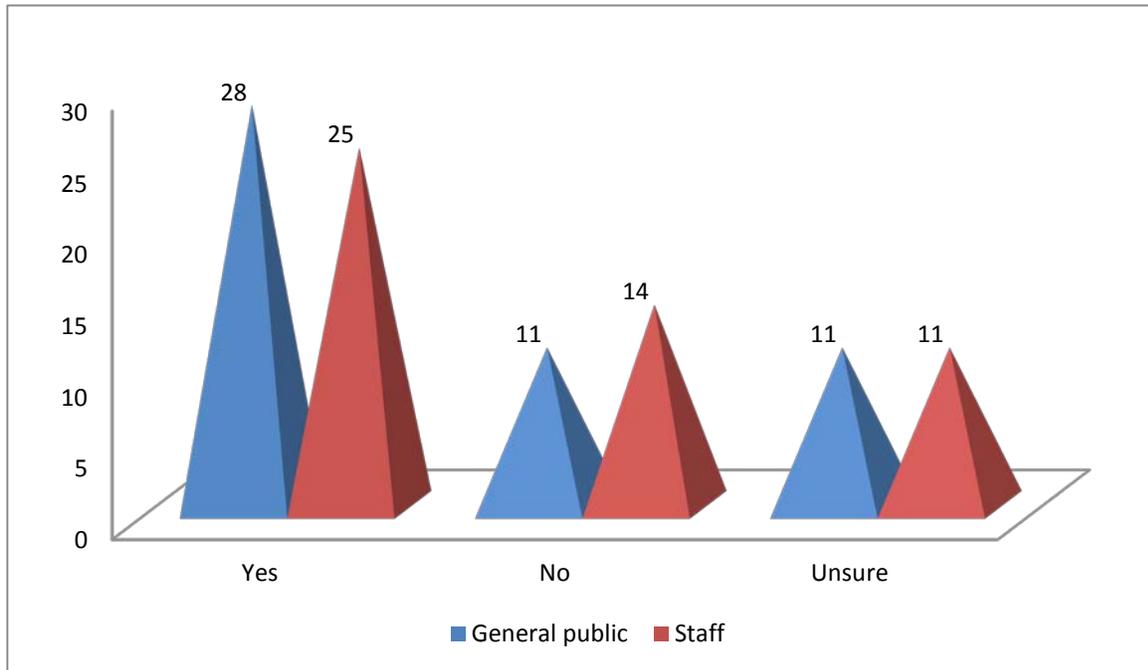
thought bottled water is convenience to their body health because it contains some minerals which helpful for the body. They said, bottled water goes through many treated, tested, filtrations and disinfections process in order to remove any contamination. As well as it specified on standards and comply with national and internationals requirements.

Some people used because of all measurements of dissolved solids and minerals in water are written. And some of them prefer it due to easy to curry and most available type which can found it in everywhere and take it anywhere without any problems. Other group chose it because it is closed carefully and away from contaminants and pollutants. As other group has difficult access to clean water (appendix 1 AND 2).

#### **4.7 The affects of bottled water on human and environment**

Bottles water con pose negative and positive effects on both environment and human being. Such effects of bottled water depend on some factors such as the type of bottles used, the storage of such bottles and the duration of consuming the same bottles. Around 28% of

general public and 25% of staff mentioned that there is a great affects of bottled water on health and environment as shown in the figure 6 of survey finding.



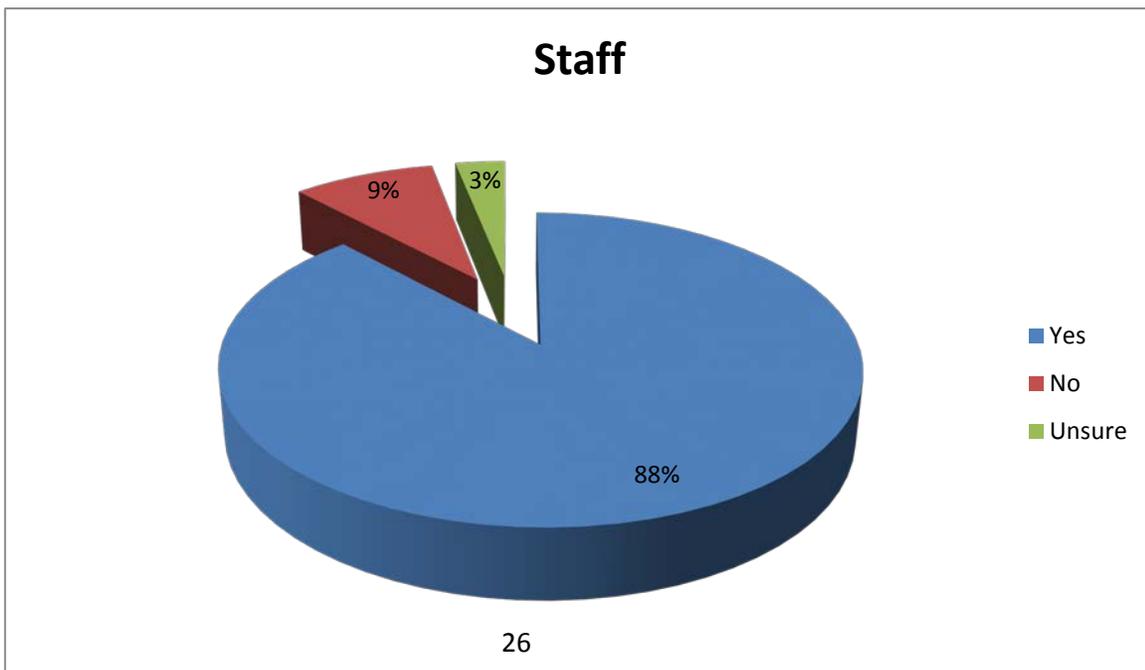
**Figure 6: Does bottled water have an effect on the environment and human health?**

In the meeting with authority's management of bottled water company conclude some of the advantage which may found that bottled water available everywhere and in any place. Also bottled water can easy to carry, it can be found in different sizes and forms such as 500 ml, 200 ml, 1.5 l, 5 l, 5 g and etc. Some of bottles water was made from PET plastic could be recycled and become environment friendly.

The bottled water industries available in a wide range in order to produce clean water and to meet the needs of water in the country, for that it provide and offer many jobs of peoples in the country which lead to reduce unemployment people.

From other hand, a group of staff in ministries states some negative effects of bottled water on human and environment. Plastic bottles water which are made from PET, this type of plastic can be used for one time only and cont be refilled again because it can leaches some chemicals components of plastic into water and may cause some health problems such as cancer. The plastic bottles water may pose a great health risk and environment hazards and around 88% of Omani staff approved that as shown in survey findings in the figure 7.

Figure 7: could the plastic in water bottles pose environmental and health risk?



They said that the improper storage of bottled water might cause some health effects for human as well. When it stored and exposed under the direct sunlight or hot environment, some chemicals of plastic may leaches in the water and become polluted and dangerous to health.

As well MOECA estimated that the plastic bottles could increase the garbage's and litters in the local environment. The plastic bottles if disposal in landfill, takes long time for decomposed because the plastic is non degradable. If plastic bottles burned, it release many

of toxic and harmful substance to surrounding environment and may cause air, land and groundwater pollution (appendix 1 AND 2).

More than that, they explain that the bottled water after produced need to transport it from the industries into the sellers and markets may for large distances that required different types of transports like chips, cars, train and etc. Which release some toxic and harmful gases result in air pollution and global warming may cause some health effects like coughing, eye, skin and respiratory irritation, difficult to breathing etc (appendix 1 AND 2).

#### **4.8 Roles and regulations related to bottled water**

The regulations and laws always play an important roles in maintain the safety and health of human and environment. In the bottled water sector there also many regulations are implemented which involve: manufacturing process, biological and chemical hazards, safety guidelines and other safety standards of human health and environment impact. According the discussion with Deputy Director of well permitting department and Senior hydro-geologist, Assistance Director Water resources development department, in Oman

some bottled water regulations are provided by the MRMWR which also responsible of its implementation. For example, Establishment of Purification and Filling water industries is one of these regulations. It contain certain conditions for submission the application of establishing the water industry, such as licenses, implementing fees, Irregularities and Sanctions additional to general provision and the method of applying the sanctions. Licenses are provided usually based on the category type of plant which depend on the amount of factory production (appendix 2).

Omani Standards and standard method for examination of water and wastewater is another regulation of bottled water in Oman that complies with world standards which administrated by regulatory bodies of MOCI. During the meeting in MOCI the authority people said that, the act (O.S 8/2006) has indicated its policies to be aligned with (WHO). It indicates and set up the maximum level of chemicals and PH allowed in the water. As well the bottled water production in Oman must be complying with ISO and GSO 1025/2009 standards which set up for water quality of drinking water and examinations of chemicals.

(MOECA) is responsible to setting up all general policies, programs and preparing plans for controlling pollution types in the country as well protecting the environment from any hazards threaten people. In the interviews with MOECA regarding bottled water found this ministry provides regulation to deal with the empty plastic bottles. They deal with plastic waste through the Regulations of the management of non-hazardous solid waste (Ministerial Decision no 17/93). The act specifies methods and conditions on which manners should be used in dealing with empty bottles (appendix 2).

Manager- Quality Assurance of Oasis Company has state in the interview that MOMP is associated with water industry in Oman which set up system of health and safety of employer, employees and environment in the role (Ministerial decision no. 286/2008). The regulation determines duties and responsibilities of employer and employees. So everybody associated with the organization is aware of its health and safety aims and objective. As well it identifies hazards and risks and set out specific action that must be taken to ensure safe workplace conditions. (appendix 2).



# chapter no: 5

## **Discussion**

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Oman is located in arid area characterized by several weather conditions, low rainfall, semi desert area, very high temperature in the summer and absence of rivers. Oman obtains potable water through Aflaj system which is water channels connected to gather extending from tops of mountains to populated areas and that water is carried by the earth gravity over long distances without using pumps or any other machines. Also it obtains water from Dams, wells, ground water and some springs are available in some areas. In last decades, many studies has been shown that the GCC countries including Oman have low supplies

of fresh water in the world and the ground water and the ground water extraction rate has become less than before as desalinate water with bottled has become the main sources of drinking fresh water (Water Report 34, (2009)).

However, Dr All-Hinai acting director general industry (MOCI) said “now the country likely shortfall in the domestic water market estimated to be around to 40 million m<sup>3</sup> liters therefore, there is a plan to increase bottled water production by existing plants or allow setting up new plants of bottled water”. Also there is study at banning exporting bottled water out of country in order to maintain ground water and to cover domestic demand of bottled water (Blog Z, (2012)).

According to N.Janardhan CEO manufacturing Zubair Corporation which runs Oman Oasis of bottled water company said such action of banding exporting bottled water from neighbors will increase the pressure on Oman bottled water markets and will provide great chances for local companies to increase their sales and production and that may lead to increase threat consumption of bottled water in the country (Zafar M, (2012)).

Barzman National (LLs) is one of market leader of bottled water company in Oman supplying pure natural water, which had reached its maximum production capacity and it is searching for a fast high capacity production with sustainable efficiency. The company has emerged and deal with African press organization “sidel line” which is the leading global producer of PET for liquid packing. The line will be installed in January 2014 in order to produce different size and shape of bottled water at speeds of up to 22,000 bottled per hours (APO, (2013)).

National Mineral Water Company state that demand of bottled water has been increased slightly in the country during Iraq war in 2003 also due to increase visitor and tourists number especially in Al-kareef seasons of Salalah (National Mineral Water, (2004)). The acting manager of Dhofar Beverages and Food Stuff company said that the production of bottled water in the company is increased more in the summer than winter season which reach sometime to 30% of total production of beverage. The company produce more than 14 typed of drinking beverage including 2 lebles of bottled water which delivered around country in 300 ml, 500 ml and 1,5 liters (Jeeni, (2011)).

Mazyounah Mineral Water Company produces 4 trademarked of bottled water which represents 30% of water production in Oman. The company produces 20,000 cartons daily

each carton has 12 bottles. All these marked filled from the company well ground water but it is various in the component and prices. The bottled water price often depended on the packing materials which nowadays increased for example one tone of cartons was produced by 700 dollars but now it cost more than 1200 dollars this lead to increase bottled water prices (Jeeni, (2011)).

The director of OCTAL manufactures PET explained that the increase in oil and raw materials prices are the main reasons to raise the cost of PET which has effects on bottled water. A carton containing 12 bottles of water of 1.5 litters was available at RO 1,300 earlier but now is sold for RO 1,600. Same thing happened to 0.5 litter bottled water the price went up. The general manager of national mineral water company said the company raised the price because bottled water material these days is very expensive. The PET was available for us \$ 300 atone last year, now it cost us \$ 2,000 per a tone. another reason of increasing price of bottled water is to increase workers salaries (Al Musalmy S, (2011)).

The supervisor of Oman Oasis company mention that the increasing of bottled water price was result of PET prices has gone up while Oman refreshment company supplier of Aquafine bottled water said the increasing of prices of bottled water is only a correction of water prices (Al Musalmy S, (2011)).

### **5.1 Reasons of using bottled water in Oman**

Some consumers drink bottled water because care of their health and believe that drinking conferred additional health benefits. It is contain minerals elements which are good for body nutrition. As other people with some medical problems or weakness in their immunity system are commitment to use bottled water which is more safety than tap water to maintain their health. Another group consumes bottled water result of responding to advertisement which is based on well being, sliming, energy and fitness so they use it as a healthy alternative instead other beverage. Many of people object to the taste and odour of

chemicals, particularly chlorine that used to purify municipality water and they fear of water running in rusty urban water pipes to be contaminated or sanitary hazards of toxic substance and many people said that we don't know how tap water storage or how the tanks is cleaned and water disinfected. They aware of corrosion are available in pipelines and they are not happy about hardness of tap water (Ferrier C, (2001)).

Some people in mountains and remote areas use bottled water because they don't received organized piped water supplies. As well their ground and surface water is not clean and there is shortage of freshwater. Another group mentions that bottled water is more safety, secured and protected. It has great nutritive value and regulated by international standards they said. Some of other states that changing in working habits and life style are the reasons of using bottled water. They said bottled water available everywhere and you can obtain without difficulties. It is light easy to carry specially during work time or travelling and it become as habit to use in offices, working site and when going out with friends.

People in semi desert area don't have access for fresh drinking water therefore they depend on bottled water to meet their domestic demand. They said due to increasing of living standards and availability of various transportations enabled them to buy bottled water from long distances in enough number for long time. People in regions where depending on wells water, they are enforced to used bottled water for drinking due to high salinity of the water wells and decade line of ground water. Less number of people doesn't have specific reasons to use or buy bottled water.

Anyway, there are other factors lead to increase using bottled water in Oman including:

1. Increase in population with short drinking water resources.
2. Huge tourism potential
3. Leisure and business
4. Restaurants and hotels
5. Hospitals and schools.

## **5.2 Compared of water prices in Oman**

In Oman the price of bottled water is much high compared to tap water that provided by government. In the searching found that tap water prices range from 10 Baiza to 15 Baiza per one gallon which equal to 5 pence £ while one carton of 12 bottled water size 1.5 litter total of 18 liters cost 1,300 R.O approximately 2£. So, the tap water price is cheaper comparing with the price of 18 liters of bottled water. Actually, more than 90% of bottled water cost paid goes to the process and manufacturing material of plastic bottles other than the water itself. Consumers of bottled water not paid only for water but they also paid for bottling, packaging, marketing and profit of bottled water and they contribute to succeed the business while consumers of tap water their cost paid goes for water only (Ferrier C, (2001) and interview results).

### **5.3 Human health and environment impacts**

Plastics invention has become very popular in the modern society of human life, which is very much in used of making bottled water it is easy to make, very handily, light weight, water proof, corrosion resistant and easy to discard. Unfortunately, many of plastic bottles water may be responsible for some pollution problems. The most threaten might be in the non biodegradable nature of plastic bottles, which never degrades and remain there for long period causing harm to environment if a necessary action is not taken.

These uncollected used bottles water might get in to water drains and eventually blocking their flow, causing severe water logging problems including flooding and create menace in the sanitary systems which may require a huge expenditure to clean them up. It may end up in the costal live and get bulled by waves into marine environment which remain floating there long time, that may lead to create some hazards to fisherman due to stack in their fishing nets or interfere into boats and ships engines machines breaking them down (Derraik J (2002) and Schriever N, (2013)).

Besides that, marine animals and birds such as whales, turtles, dolphins etc may effected by discarded bottles water as result of the consumption of plastic by eating or swelling plastic bottles causing death or chemical toxicity. Some of bottles is broken up into small pieces that might ingested by marine birds leading to death. Empty plastic bottles may are scattered around the public gardens and villages spoiling views of the natural environment and social places. All that gives unwanted looks to tourist or visitors. Also these consumer bottles might form good environment for growing and breeding grounds mosquitoes which accumulate inside it loading to borne disease (Green living tips, (2010), Schriever N, (2013) and Derraik J (2002)).

Some things might happened through land filling the used bottles may become as starting point of spreading disease and infecting in additional it never decomposed or recycled by environment which may also caused solid infertile, ecological imbalance and water contamination leaching problems.

Disposal process of unwanted or unusable recycled bottles water by incineration may release an exceptionally high toxic chemicals gas into atmosphere such as CO<sub>2</sub>, CH<sub>4</sub>, SO<sub>2</sub> etc leading to increase air pollution, increase air temperature, massive smoke as well as health impacts such as cancer, respiratory disease, eye and nose irritation, With these impacts there is also another economy effect. The incineration process itself required energy and fuel additional to transportation cost and the amount of gases that released from transporting process.

Many studies showed that manufacturing bottled water and its process including filling, treating water, labeling bottles, selling and transporting over the world required high demand of energy and fuel (Griffin S, (2009)).

So the consumption of fuel and energy may lead to release several types of toxic gases include to transporting which release CO<sub>2</sub>, SO<sub>2</sub> etc. These emissions may add more pollutants in to air and increase hazards size in environment involve increase in greenhouse gases, potential global warming, photochemical ozone formation, changing in climate and nitrification (Arnold E, (2006) 2).

The high demand of on bottled water specially on purified water and natural mineral water might cause excessive pressure on local water resources and might increase concern of extend to ground water specially in countries where already facing problems of water shortage like Oman. Water extraction for bottling operation might put an additional stress on local and ground water resources leading to decrease fresh water levels in the ground and might increase water salinity (Ferrier C, (2001)).

Recycling PET of bottled water process absolutely will required energy and consumes a huge amount of fuel to prepare them again in usable products which means generate another greenhouse gases. The big issue is that PET plastic of bottles is not recycled in to another water bottles but it is produced into other products which may by discarded after consumption again in environment or landfill. In this procedure the volume of plastic waste might double increase in the future, so bottled water lead to increase global growing of plastic waste (Griffin S, (2009) and (Arnold E, (2006) 2)).

Plastic management is challenges issue for Oman because of high usage and consumption of plastic application including of bottled water with population of almost 3 million inhabitants the country generate about 12% percentage of recyclables plastic waste which is may sent to authorized and unauthorized dumpsites for disposal creating several health and environment impacts. The problem of plastic waste management in Oman is characterized by lack of collection and disposal facilities (Zafar S, (2013)).

Sadly, the Sultanate of Oman doesn't really do that much recycling of plastic bottles. It is have only some papers and metals collections for recycling in the Capital Muscat. Most of

the waste goes into the some bin and there is no public recycling points in cities. But some bottled water companies like Masafi, Tanuf and the environment society of Oman (ESO) have some activities programs in increasing of plastic bottles which involve collecting, blending and storing the bottles then transported over the border to UAE or India of recycling (Environment Society of Oman, (2009) and Sythe, (2009)).

The plastic bottles collected is sent to Masafi's plant in Ras AL khaimah in UAE for pre-processing and after that transferred Fujairah in Horizo Technologies PZE for recycling, where it is formed into another plastic application. The plant used to recover more than 600-700 tons per month of PET plastic bottles for recycling and the plant had ability to recycle more than 2,000 tons per month. But unfortunately, the government of UAE announced to stop and shutdown the plant operations due to unresolved government policy. The recycling plant in UAE is unable to accept the plastic bottles currently (James A, (2012)).

# chapter no: 6

## 6.1 Recommendation

Out of 2.5 million plastic bottles which consumed every hour only one out of four was recycled and the rest went up to landfill or thrown away result in increase plastic waste amount and that add additional serious damage to the surrounding environment due to its production and disposal ([Green School Alliance, \(2013\)](#)).

Government should be committed to create and develop more effective improvement on tap water “municipal water” to be seen by civilian as the best choice for safe, clean drinking water. Good maintenance of water supply, for example filtration, Osmosis and reduce mount of chlorine substance that used in treating water, so that may lead to reduce the consuming amount of bottled water and might perhaps result in decrease the growing of plastic waste also may minimize some human health effects.

The WHO establish a lot of guideline for bottled drinking water quality which should be used in country as bases line to create its own national regulation as well the WHO guidelines provide risk assessment to health and safety from biological and chemical component of drinking water including to measure control, environment impact and economic factor ([Coutsoukis P, \(2008\)](#)). Therefore, the bottled water industry in Oman should contribute to find some solutions through reducing the use of PET plastic in water bottles and should replace it where possible with some material less harm to health.

Recycling plastic items may play significant role by exploitation this waste to other useful products and save the raw materials. From economical side the recycling could help to reduce landfill area where reused for farming purpose. So, through this methods may provide employment opportunities in both side agriculture and recycling.

Recycling plastic bottles of water production required establish a cooperation system among bottled water plants, government and public masses, so should all working to gather with industry sector to develop good collection, recycling programs. For example, government should provide collection bottles points and bottled water consumer should follow the instruction of discarding manners. Bottled water factories are responsible of collect and ship these wastes to industry sector for recycle or reuse.

It should be the duty of the local municipal authorities and bottled water companies to keep separated garbage bins for empty bottles which then get collected and send to recycling purpose. The government may play <sup>39</sup>a key role in this regard by apply some regulations.

The proto-chemical industrial firms and all major fabricators of plastic water bottles have to be forced to disclose publicly the manner in which their product can be recycled to yield eco-friendly environmental. As well they should be come forward to finance the projects for trading and processing for recyclable bottled water wastes.

Reduce; reuse and recycle could be the best alternative methods to reduce environment hazards of discarded plastic bottled. So, Oman government should start planning for establish their own recycling plants.

Promoting and increasing public awareness is another great reduction tool of target empty bottles pollution. So, mass awareness should be started right from the beginning of school education, campaign through radio and T.V channels and organizing seminars etc. that would be of immense value and would go a long way to reduce the problem size.

## 6.2 Conclusion

Water is obtainable everywhere but not a drop is useable to drink. Many consumer living in urban regions who are increasingly looking toward bottled water as remaining choice of meeting their daily need of fresh clean drinking water because there is great concern for the quality and safety of drinking water and that gave bottled water a good chance to be develop rapidly. There is estimation mention that 2 litre per day are consumed by adult person and 1 litre for 10 kg childe (Coutsoukis P, (2008)).

The report has analyzed bottled water industry in Oman will might grow rapidly as long as water bottles sales still continue to increase and as the municipal tap water is still not free from test and smell because tap water may not comply with the public requirement . In the country the consumption of bottled water might seems very high according MOCI that bottled water companies produce range from 316,000 l to 70,000,000 l daily, but may be at least Oman is less than other GCC such as UAE and Saudi Arabia which currently consider as the highest countries of consuming bottled water in the world. However, the water bottles may lead to create several environment impacts as studies and investigation shown that whether measured by crude oil used, energy consumption, greenhouses gases emission and massive plastic waste or measured by excessive exhaustion of groundwater. Adding to that water in bottles itself may not safe as much as people thought and it could not be 100% clean more than tap water which may be contaminated by range of physical hazards or chemical microbial during packing, filling and storing places or even may get toxicity due to plastic substance leaching (Coutsoukis P, (2008)). Besides that, should take in account the risk of disease that might affect workers who dealing with bottled water manufacturing in the plant.

The first step, Oman government should give more attention to tap water by an effective developing technology to maintain and protect municipal water with all public water resource and government should be responsible to ensure delivering safe drinking water to

whole residents, in order to encourage public using tap water as alternative source. So, this step might help replacing the use of bottled water. At second step, the government should focus more on recycling programs whether by enforce restrict legislation to bottled water companies or by find suitable methods for getting off the discarded bottles. The next future research will required more cooperative from government to explain and understand why tap water still not comply with public requirement, in addition will need to study the reasons of low quality of municipal tap water. As well as going to find out better measure control to reduce the usage bottled water.

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# APPENDIX

# APPENDIX NO. 1: SURVEY

## **Questionnaire for General public**

1

1. Which type of water do you prefer??  
Bottled  
Tap  
Filtered

None

Why do you prefer that .....

2. How much water do you consume daily?

1-3 bottles

4-7 bottles

8 and more

None

3. Do you believe that bottled water has a negative effect on the environment and human health?

Yes

No

Unsure

Please explain Why.....

4. What beverage do you prefer over water?

Tea and Coffee

Soft drink

Juice

16  
Questionnaire for General public

1. Which type of water do you prefer??

Bottled

Tap

Filtered

None

Why do you prefer that ..... clean and doesnt  
cost many and always  
available

## **Questionnaire for staff**

1. Which type of water do you prefer??
  - Bottled
  - Tap
  - Filtered
  - None

Why do you prefer that .....

.....

.....

.....

.....

2. How much water do you consume daily?

1-3 bottles

4-7 bottles

8 and more bottles

None

3. What beverage do you prefer over water?

Tea and Coffee

Soft drink

Juice

Beer and other alcoholic drinks

Other.....

.....

4. Is the bottled water safer than tap water?

Yes

No

Unsure

Please Explain why .....

.....

.....

.....

5. The water used in the bottled water, where does it come from?

.....

4

.....

.....

.....

6. Does bottled water have an effect on the environment and people's health?

Yes

No

Unsure

Why.....  
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7. Could the plastic in water bottles pose environmental and health risks?

Yes

No

Unsure

Please Explain why .....

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8. Are there any policies and regulations regarding bottled water in Oman?

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.....  
.....

37  
Questionnaire for staff

1. Which type of water do you prefer??

Bottled

Tap

Filtered

None

Why do you prefer that because bottled water protect water sources from  
bacteria, chemicals and other contaminants.  
good quality control processes to ensure the quality of  
bottled water.

5. The water used in the bottled water, where does it come from?

Municipal water 6

6. Does bottled water have an effect on the environment and people's health?

- Yes
- No
- Unsure

Why... Its having environmental impact. ~~of~~  
The single management... ~~is~~ ~~the~~ ~~world~~



# APPENDIX NO. 2: INTREVIW

**Interview with: Manager- Quality Assurance in Oasis Bottled Water Company**

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**Is bottled water big business?                      8**

Off course yes, our aims is to provide safe drinking water to consumers and provide good quality products in everywhere.

**What kind of water does company produce?**

We are produce two kinds of drinking water:

1. Oman oasis balanced drinking water
2. Oman oasis oxiplus water

And these two produced in 500 ml, 200 ml, 1.5 l, 5 l, 5 g. also our company produce Oman oasis Delite “ orange, mango, Cocktail juices drinks” which export the the juice from Saudia Arabia and soled in Oman.

**Where does bottled water come from?**

The water we are used here in the company is from ministry supply water.

**How long have you been producing bottled water?**

We are produced bottled drinking water since 1994 until now day and our products are developed each year.

**How much do you produce daily?**

We are produce different sizes of bottled drinking water for that the quantitiy we are produced daily will be different depend on the size of the bottles such as:

We are produce:

1. 500ml, 1.5l, 2l about 10,800 bottles per hour and about 259,200 bottled per day
2. 5 l about 1,000 bottles per hour and 24000 bottles per day
3. 200 ml about 6,7520 bottles per hour and 81,000 per day
4. 5 g about 1,350 bottles per hour and 19,000 per day

**Which type of plastic do you use?**

We are used PET plastic in our bottles

**What other chemical components that used for making bottled water?**

We used PC plastic in some types of bottles water such as the bottles of 5 g

**How much quantity of oil and energy does bottled water required to be produced?**

We used energy approximately around 3,500 units per day to produce our products of bottled water.

**Can you tell me about chemical components that bottled water contained?**

We use many chemicals in bottled water such as Calcium (Ca), Magnesium (Mg), Sodium (Na), Potassium (K), Iron (Fe), Manganese (Mn), Zinc (Zn), Copper (Cu), lead (Pb) and many other anions present in the bottled water components.

**How is bottled water labeled?**

The bottled water is labeled by writing the Brand name, chemical contents, shelf-life and storage conditions, barcode, the quantity, net contents and etc

**What about the waste?**

The general waste is segregated like plastic or papers and sent to recycling. In these waste we use the 3Rs “reuse, reduce and recycle” and that protects our products from contaminants also to protect the environment from other hand.

**How do you deliver bottled water to market? And what is the cost of transportation?**

We have our own distribution team with road vehicles “trucks and seals men available” they deliver the products to the markets and places.

The cost of transportation is around 200p per carton and depends on total quantity we are selling.

**Are there some regulations applied you should follow it?**

Yes, there are two Omani standards ..... it a writing guideline for good manufacturing which provided from the ministry also some people from the ministry come frequently to do audit. Also there are other regulations and standards requirements which should be followed in daily job such as ISO22000, ISO 14001, NSF and ABWA.

**What is your environment measurement?**

We run our business in such way less environment impact. Preserve protect and enhance the environment. Actually, our company satisfies with environment management system ISO 14001.

**In your opinion what is the main reasons for people using bottled water?**

Because, the bottled water is safe than tap water for that the people used bottled water for their health safety also the bottled water is tasted and conformed for personal safety requirement and by that ensure it is safety for people than tap water.

**Are the plastic bottles safe to reuse?**

Not all plastic of bottles water are safe for reuse. The PC (Polycarbonate) bottles are safe for reuse but PET bottles are not safe for reuse and only it safe for one time use because there is a chance for some harmful chemicals will come into water when they bottled are reuse.

**How long does bottled water last expire?**

1 year only

**Do you have collection place or recycle plant for used bottles?**

Yes, we collected any waste and send it to recycling plant.

**Interview with: Director of planning and studies: Ministry of Environment and Climate Affairs**

11

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**Which type of water do you prefer?**

I prefer to use bottled water because it is safer than tap water and healthier.

### **What are the reasons behind why people prefer use bottled water?**

There are many reasons make people used bottled drinking water includes:

1. Health believe because people are sure that bottled water are healthier
2. Compliance with the standards
3. More clean
4. Easy to disposal
5. Can be reuse
6. It contains some chemicals

### **Why do you think that tap water is not safe for people used?**

Because tap water is not clean and the percentage of chlorine is very high and that appears in the taste and odor of tap water also the pipeline which are used is not clean and it has many contaminants which make tap water not fit for people use.

### **Are there any rules and regulation regarding bottled water in Oman?**

Yes, the standard of bottled water is should be met with WHO or national standards.

### **What are the negative effects of bottled water on environment?**

The main environmental impact of bottled water is the used bottles, until now we don't have recycled plant for bottles. Actually, the used bottles finally go to dumping but it does not degrades easy, it take very long time may take many years to degrades. The other problem if it is degrades will effects the ground water.

From other side, I don't think that bottled water has any effects on human health, in fact it has benefits.

**Interview with: Deputy Director of well permitting department: Ministry of Regional Municipalities, Environment and water resources**

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**In your opinion, is the bottled water safe than tap water?**

Yes, and that for several reasons:

1. Clean from contamination
2. Tasted
3. Provision for drinking
4. Healthier
5. Satisfied by specific standards

**What are the sources of water used in bottled water?**

There are two main sources of water which are:

1. Wells water is clean and pure water
2. Desalination water

**What are the reasons behind why people prefer use bottled water?**

1. For health maintenance
2. the municipality water is may expose to contaminations
3. pure and clean water
4. easy to carry anywhere
5. available everywhere
6. cheap doesn't cost huge money
7. Easy to use
8. Easy to store
9. Good for health
10. Reduce water consumption

**What are the negative effects of bottled water?**

1. The shelf life may not be enough
2. The plastic used may have health risk to people
3. Not free

**What are the sources of water in Oman?<sup>13</sup>**

There are two resources in Oman include natural which called as conventional resources and non-natural resources which called as non-conventional sources. As well as The natural resources has several types such as surface water and that include the rainfall (rainfall is the principal sources of all freshwater on the earth) and Wadis (it describes both a water-

made cut through a mountain range and a river of gravel distinguishable on a wider alluvial plain that stores fresh surface water originating from a mountain range). The other types are the groundwater and springs. More than that, the non conventional resources involve the desalination plants (desalination of seawater or saline/brackish groundwater has become an important contributor to water supplies where natural water resources are unavailable or inadequate)

**Interview with: Environmental inspector: Ministry of Environment and climate Affairs**

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**What are the negative effects of bottled water on human health and environment?**

The bottled water has several negative impacts in both sides on human and environment. In fact, the plastic of bottled water not degraded and if it send to landfill or incineration will shows or appears many of environmental problems like toxic, harmful and Carcinogen gases. Also the wastes of bottles will Deformation the general view of place. From other hand, the bottles water may effects aquatic life if it thrown on the sea.

But for human will effects the health by the material and chemicals used in bottled water. Firstly, the plastic used in bottles is PET which extraction from oil and that may pose some health effects. As well the chemical components which added to water it also may pose some health risk if it exceeds the specific level.

### **What do governments do to reduce the negative impact of bottled water?**

Until now there is no real solution for these impacts but the governments do some studies related to the plastics in cooperation with some companies such as Oman Holding Company to reuse the plastic in Oman and reduce the impact of these plastic bottles. Also they think to add some materials help to decomposition the bottles quickly.

### **What are the positive effects of bottled water on human health and environment?**

Off course for everything in our live has negative and positive effects and for bottled water I think it has also some positive effects such as:

1. Easy to carry
2. Beautiful shape
3. Can used in scenery
4. Available everywhere
5. Doesn't cost very much money
6. Clean and safe

**Interview with: Head of exemptions department: Ministry of Commerce and Industrial**

In Oman there are about 22 factories which producing bottled water.

Are all the bottled water which produced by these companies are being consumed in Oman only or for export as well?

Actually, in the past the bottled water was imported from abroad (UAE, Saudi Arabia) because there was a lack in water by 40%. But in the since of 2013 have been issued a decree of banning the companies from exporting the bottled water to abroad are to cover the shortfall of the state.

**What are the sources of water used in bottled water?**

There are two sources of water that allowed for companies to used include:

1. Ministry supply water
2. Wells water

**Is the bottled water safe than tap water?**

In fact, the ministry supply water (tap water) is usable to use but it is not apply or satisfy to the health standards and conditions.

Are there any rules and regulation regarding bottled water provided?

Yes, there is a standards of water we given to bottled water manufactories which should to be follow it.

**What are the negative effects of bottled water on human health and environment?**

There are some important effects like:

1. The plastic used are PET and that may pose some health effect.
2. The manufacture is formations the bottled then directly filled with the water which may leads to the presence of certain minerals in the water
3. Some bottled con not reuse.

**Interview with: Senior hydro-geologist, Assistance Director Water resources development department: Water Sector**

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**What are the reasons behind why people prefer use bottled water?**

Previously, people were dependent on ground water for their purposes, but because of population growth and increased demand for water due to ongoing development, ground water has become contaminated, leading people to use bottled water instead. Also, people's fears about desalinated water, due to its taste, and concerns about the cleanliness of municipal pipelines, have led to a preference for bottled water because it is easy to carry and available.

### **Other Interviews questions**

How much bottled water is produced in Oman?

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Approximately, how much bottled water is consumed in Oman?

What are the reasons behind why people prefer use bottled water?

Is the bottled water safe than tap water?

What are the sources of water used in bottled water?

How is the bottled water produced?

Are there any rules and regulation regarding bottled water in Oman?

What are the positive effects of bottled water on human health and environment?

What are the negative effects of bottled water on human health and environment?

What do governments do to reduce the negative impact of bottled water and what is still to be done?

Is bottled water big business?

What kind of water does company produce?

18

Where does bottled water come from?

How long have you been producing bottled water?

How much do you produce daily?

Which type of plastic do you use?

What other chemical components that used for making bottled water?

How much quantity of oil and energy does bottled water required to be produced?

Can you tell me about chemical components that bottled water contained?

How is bottled water regulated?

How is bottled water labeled?

Describe health and safety measurement in the plant?

What about the waste?

How do you deliver bottled water to market? And what is the cost of transportation?

Are there some regulation applied you should follow it?

What is your environment measurement?

In your opinion what is the main reasons for people using bottled water?

Are the plastic bottles safe to reuse?

How long does bottled water last expire?

Do you have collection place or recycle plant for used bottles?