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THE WORLD AROUND BOTTLED WATER

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2.1 Introduction

Water is the main constituent covering 71.4% of the earth. But irresponsible and nonsensical use of water makes it unavailable for future generation (Kulshreshtha, 1998). Pure water is soft with no characteristic smell; but when it comes in contact with soils on the surface of the earth, different chemical reactions occur and different useful minerals dissolve to render it hard. We cannot live without water, it helps to maintain body temperature by sweating and is the main part of blood to provide nutrients to different parts of the body. Water is used in many different ways which include: washing, gardening, cleaning, etc., but use of water for drinking purpose is the most important one. Water makes up about 60% of body weight in men and 55% in women and for infants it is about 70%–80% (Miller, 2006). Water is, in fact, incredibly important aspects of lives.

Drinking water quality is mainly determined by standard total dissolved solid (TDS). Different country has different regulation for the TDS level, in United States it is 500 mg/L while in India it is 250 mg/L. The TDS actually comprises inorganic salts and small amount of organic matters dissolved in water. Main constituents for TDS are cations of calcium, magnesium, sodium, and potassium and anions of carbonate, bicarbonate, chloride, sulfate, and nitrate (Daraei et al., 2015; Abouleish, 2012). Some organic matters also profoundly contribute to the TDS of water. World Health Organization (WHO) has set different TDS level for drinking water (Table 2.1). With the passage of time, the concern over of quality of drinking water has grown rapidly and bottled water has gained increased popularity. Bottled water has now become the synonym of drinking water, packaged in bottle. Bottled water of all brands is colorless, but it differs in taste because of different water source. Manufacturers in the rudimentary stage considered bottled soda as the option in lieu of water, which, however,

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Table 2.1 WHO Guidelines for TDS Values to Determine Quality of Drinking Water

S. No.	TDS (mg/L)	Quality
1	Less than 300	Excellent
2	300–600	Good
3	600–900	Fair
4	900–1200	Poor
5	Above 1200	Unacceptable

suffered from few drawbacks. People realized that regular use of soda may be detrimental to health and the need for bottled water was seriously felt. Consequently, there has been commercialization of water in bottles and attempts to introduce bottled water as a healthy drink.

United Kingdom was the pioneer in bottling water. In 1621 Holy Well bottling plant started bottling mineral spring water. The commercial distribution started in Boston (USA) in 1767 in Jackson's Spa. The popularity quickly led to a market for imitation of products. In 1809, Joseph Hawkins was issued the first US patent for imitation mineral water. In the beginning, people considered bottled water to possess some therapeutic properties that could help to treat many common ailments. In the 19th century large usage of bottled water was recorded when municipal water supply was contaminated with pathogens like cholera and typhoid. Today bottled water is the second most popular commercial beverage in the United States. Carbonated water is, however, still in the market along with flavored bottled water. It has been customary in recent days in most of the countries worldwide to use bottled water; but in most cases it is not driven by health concern. It is not guaranteed that bottled water is safer and cleaner than tap water. The consumption of bottled water has by and large been reliant not on the brand loyalty rather on differences in believes, perceptions, and according to its use (Wells, 2005; Gorelick et al., 2011). Consumer's choice to purchase bottled water has mainly been dependent on quality, health, environmental concern, convenience, price considerations, and most importantly lifestyle. Bottled water includes well, distilled, mineral, and spring water. It may be carbonated or noncarbonated. Bottled water is often stored for emergencies like natural disaster. Mobile treatment units have also been developed for the distribution of drinking water in small polythene bags, but for prolonged storage it has been proved to be not good for health. Engineering and technologies of bottled and packaged water are quite related to its manufacturing, distribution, and supply

of quality water purification system. These are important for designing and manufacturing the finest and most economical water. Bottled water industries do not require high manufacturing process and is based entirely on energy requirements for pumping, filling, treatment, and storage, etc. (Gleick and Cooley, 2009). The required energy for the water treatment plant can also be fulfilled by solar and wind energy (Chen et al., 2008). In 2015, manufacturing by Nestle Waters generated 22 g CO_2 eq/L and required 0.22 M of energy per liter. India is the 10th largest bottled water consuming nation in the world. The 20-L bulk water jars have found phenomenal acceptance in household and work place. Bottled water is "not guilty" in terms of environmental issue or social blight. Bottled water does not deserve to be banished from Quaker circles as a sign of spiritual, moral, and ecological depravity: The users are not heedlessly ruining the planet. It is much safer than normal tap water although the use of plastic bottles make it somewhat unsafe. Glass containers are primary alternatives of the plastic bottled in recycling terms. But glass bottles are not user-friendly especially for kids since they cannot carry these safely and broken glasses can cause more injuries compared to plastic bottles. It is, however, not directly or indirectly related to world's water problem. Even if bottled water vanish in the near future, the water consumption rate of the world would not have any significant impact.

Bottled water is very important, in the case of natural disasters or any other emergency preparedness. It is fully portable and versatile such as its use makes our life more convenient in today's rushed lifestyles. Bottled water is ideal consumer product since it is nonaddictive, alcohol-free, caffeine-free, colorless, odorless, and flavorless. The present review addresses all necessary aspects of bottled water.

2.2 Types of Bottled Water

According to origin bottled water can be classified as:

1. *Artesian well water*: Water may be obtained from underground water source under high pressure. Artesian aquifer is a layer of sand, gravel, rocks, and clay and water rises out through these layers of the outer surface by hydrostatic pressure.
2. *Mineral water*: Natural mineral water is obtained directly from the underground sources and it is collected directly from there and packaged without further treatment. Therefore, sometimes water of this kind is also called "pure water" or "untouched water."
3. *Spring water*: Spring water is obtained through a particular source, either underground or surface. Water source is protected to prevent water from pollution and it is also used without treatment.
4. *Well water*: It is the most common natural resource of water and it is used after treatment.

5. *Tap water*: Tap water is obtained from concerning river of the particular region and it can be directly bottled after treatment, like chlorination.

2.3 Bottled Water Versus Tap Water

It seems paradoxical that people decide to package and sell and buy something that is freely available; they prefer more expensive and less comfortable water source for drinking purpose. While there is no universal standard for drinking water, WHO gives guidelines for drinking water (WHO, 2017). The standard varies from country to country. Bottled water is consumed for many different reasons including taste, convenience, poor quality of tap water, and safety issues including health concern and search for a substitute for sugary drink (Chiarenzelli and Pominville, 2008). Main reasons behind increasing use of bottled water instead of tap water are as follows:

1. *Organoleptics*: The factors which affect the taste of water create dissatisfaction in people. People, in general, prefer sweet water.
2. *Health and risk*: Apart from taste, health-related issues are mainly accountable for water consumption (Abouleish, 2012); there is a common belief that bottled water is healthier than tap water. Tap water has mainly three types of contaminations: chemical (pesticide, drug etc.), physical (due to mud, sad, color, odor), and microbiological (bacteria, viruses etc.). People prefer bottled water to avoid eventual tap water risk (Napier and Kodner, 2009; Anadu and Harding, 2000).
3. *Brand name*: Most of the people nowadays are crazy for brands and style. While outside they prefer drinking bottled water rather than tap water for social status, not because of much concern about safety and health issues (Wilk, 2006).
4. *Logistic based*: Sometimes, during long journey, good quality of water is not readily available en route and bottled water becomes very important (Akabogu, 2014). Consumer's preference may vary depending on location, such as tap water is preferred at home, while bottled water at work. It also depends on the intended use such as to make tea, to prepare food, or to drink directly. Use of bottled water or tap water is also sometimes based on human psychology (Gregory and Di Leo, 2003).

Bottled water industries lowers harm as well as decreases the fear level. In practice, beverage companies play with consumers' fears of illness and contamination from tap sources. One major player in the assault on tap water is Brita filters, with the commercial ads that use "Tap and toilet water come from the same source. Don't you deserve better?" The perceptions of healthiness, as stated earlier, are influenced by organoleptic (taste) (Grondin et al., 1996). Not surprisingly,

consumption of bottled water is sometimes higher in communities that have serious problem with tap water; sometimes, tap water has excess metal ions such as Cd, Hg, As, etc. (Jakus et al., 2009; Bakurdere et al., 2013). Advanced knowledge on the factors that contribute to the use of drinking water can contribute to a better understanding of the consumers concern and behavior (Roche et al., 2012). Bottled water is, in fact, far from being an alternative to tap water. It seems to be mostly consumed as a substitute for alcoholic and traditional soft drinks. The environmental impact, container safety, water origin, emergency supplies, and role of the bottled water industry continued to be area of concern for many people. A qualitative study has been performed using semi-structured interviews, with 23 users from the Munrow sport center in the Birmingham campus. The study reported that most of the people chose bottled water for health benefits but they don't know about its nature (Ward et al., 2009). Sometimes because of marketing campaigns, people choose bottled water instead of less healthy beverage. Bottled water provides a safe, convenient, refreshing, and responsible choice.

Risk factors associated with tap water include perceptions that it is not safe for drinking, the fear that water will become contaminated through leaked pipelines and can cause illness to anyone. It is always considered better to treat tap water before use like boiling, simple filtration, etc. and most of the studies showed that bottled water is not healthier than tap water (Rowell et al., 2015; Howard, 2003). Most convincing evidence comes from a study by National Resources Defense Council (1999), and the report concluded that "There is no assurance that just because water comes out of a bottle, it is any cleaner or safer than water from the tap." In Iran a comparative study was performed between tap water, bottled drinking water, and point of use to find suitable water for drinking purpose (Dindaroo et al., 2016). In fact more than 30% bottled water comes from the tap, sometimes further treated and sometimes not. Bottled water is therefore not necessarily better or worse than tap water; it only depends on specificity of the particular cases.

2.4 Bottled Water Industry

Unfortunately sufficient safe potable water is not available everywhere. Either harmful chemical is found in the soil layer or it may be contaminated by pathogens, bacteria. If such water, enter in to the body, we get infected and suffer by waterborne disease. It has thus been imperative to process and bottle safe potable water for human consumption in prevailing conditions. Thus, shortage of pure water around the world has opened new avenues for bottled water. Bottled water industry does not require high-cost processes; it involves a

relatively light manufacturing process. Bottled water industry, through their long campaigns, has created awareness and people want bacteria free and odorless water as a health drink. Of course, bottled water is healthy and there is no direct impact on the environment by water present in bottle. However, use of plastic bottles creates environmental risk. They comply with local and state regulatory framework, which applies to other water users in the same class and will continue to do so.

Bottled industry provides mainly two types of packaged water.

1. *Packaged natural mineral drinking water*—Packaged natural mineral water showed presence of less than 250 ppm of TDS (Whelton et al., 2007) (IS 14543, Indian standard code). Natural mineral water can further be divided into two subclass, that is, premium natural mineral drinking water and natural mineral water. Examples are San Pellegrino, Evian, Perrier, Himalayan, Catch, etc.
2. *Packaged drinking water*—Packaged drinking water is water derived from any source of potable water (well, bore well, ground water, etc.) which may be subjected to different treatment processes such as decantation, filtration, aeration, reverse osmosis, etc. By all this processes water will get disinfected for a long time period (IS 13428, Indian standard code). Examples are Parle, Bisleri, Coca-Cola, Kinley, Aquafina, etc.

Bottled water industry process disinfect water by means of chemical or physical processes, for example, ozonation, ultraviolet treatment, silver ionization, etc. The development of microorganism is controlled to a level that is suitable for consumption. The processed water is then filled in sealed container of various size and shape for further direct consumption. Packaging material should be thermo-proof, tight, and impervious.

In India, the bottled water industry boomed in the late 1990s, just after Bisleri launched its packaged drinking water. After that several companies have come up, that is, Aquafina, Tata water plus, Kinley, Himalayan, Bailley, Kingfisher, etc. Due to perceptions made by bottled water company overall sales growth and consumption has increased tremendously. Parle Bisleri is the market leader in India. It shares more than 45% in the branded bottled water, while Coca-Cola Kinley comes second with 15% share (Dhal and Mitra, 2015). Bottled water industries have also grown in other countries, for instance, Lebanon has one of the highest growing consumers of bottled water, and New Zealand allowed fluoride in bottled water. Bottled water industries, for the competitiveness in the market, need to lower the price (Woods, 2009) even by sacrificing or adjusting some of desirable quality parameters through some sort of flexibility. Some industries focus on people's taste and therefore they reduce TDS of water since a low TDS value gives sweetness to water. Among all the brands of bottled water Nestle and Coca-Cola are the leading bottled water manufacturers in world.

The global bottled market was valued at more than US$170.0 billion in 2014 and is expected to reach US$280.0 billion by 2020 (Deerfield Beach, 2017). The bottled water market is a witness to rapid growth of civilization and indicates high awareness for cleanliness. Fast growth of tourism and portability of hygienic bottled water trigger demand for bottled water. However, stringent regulations regarding packaging of water and bottled water standard are expected to hamper the growth of the market to some extent.

2.5 Manufacture of Bottled Water

Water is a very sensitive product on both microbiological and chemical levels. One of the main challenges faced by bottled water processing is to consistently produce a quality product free of pathogenic organisms and protozoa that may change its quality, reduce its shelf life, and become a pathogenic threat to customers. Sometimes bottled water obtained from surface water sources or plant may have a more consistent taste than tap water. Strict production control is critical to avoid any contamination of pathogenic bacteria or protozoa. Water treatment plant processes water according to quality of raw water and requirement of the region. Plants treat water following different processes. Common processes are: coagulation, filtration, and disinfection. Bottled water processing, in general, consists of the following steps.

1. *Filtration*: Water must be free of any contaminants that may spoil its quality.
2. *Tank venting*: The air in the storage tank must be free of microorganisms to ensure that the stored water is not contaminated.
3. *Carbonation*: Carbonation is the step of adding carbon dioxide to water. It is used to produce sparkling water. The CO_2 that is injected into water must be free of particles and microorganisms.
4. *Bottle blower and bottle washer*: To maintain the quality of the water and its shelf life, use of a safe and reliable container is essential. The air used in the bottle blower to turn the preforms into the final PET bottle must be free of contaminants; its filtration ensures a bottle with low bioburden is produced. Bottle blowing can be done during any stage of the process using PET bottles. The water used to rinse PET bottles must be free of contaminants; its filtration ensures good quality of the bottles prior to filling.
5. *Bottle filler*: Gas filtration can also be used during the filling process of carbonated drinks. In order for the filling to be possible, the filler bowl must be pressurized, and it is essential that the gas used is microbiologically stable.

   Bottled water manufacturers have reduced the thickness and material quality of bottle; they also have focused on comfortable structural design (Fig. 2.1).

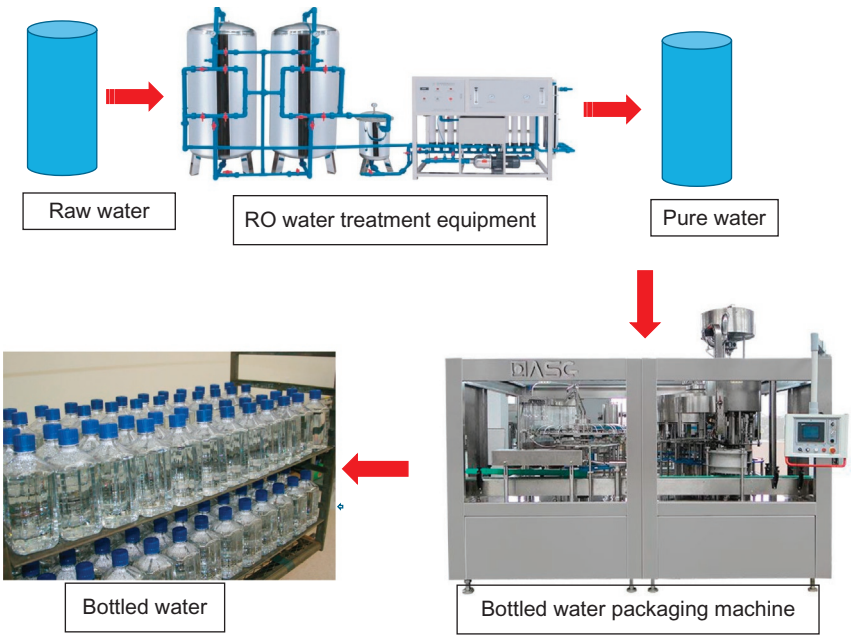

Fig. 2.1 Manufacturing of bottled water.

The PET is modified by copolymerization by the use of added comonomer. The PET is relatively strong, withstands high temperature, and has good barrier properties against moisture, oxygen, CO_2, alcohol, and solvents. It can be made transparent by limiting crystallinity using copolymerization, by adding fillers, or by controlling cooling when melt processed during manufacture. The PET bottles made for filling water are amorphous with low crystallinity for clarity and toughness. It has highest recycling rate.

2.6 Labeling on Bottled Water

In most of the cases, it has been shown that bottle water is actually tap water. However, it is also a matter of contention that the quality specifications for some bottled water in some jewels jurisdiction are more stringent than the standard for tap water. Sometimes bottled water is mentioned as distilled water or purified water. There are different terminologies written on the bottled water for packaging material (Table 2.2). Label on bottled water should clearly mention following information: brand name, type of bottled water, source of water, ionic composition, volume, bottling, expiry date, company name, address, country name as well as treatment strategies employed. For convincing people, bottled industries offer a variety packaging options: 100,

Table 2.2 Description of Plastic Containers Used for Water Packaging

S. No.	Types of Container	Description
1.	Jar	Reusable plastic container
2.	Bottle	One time use plastic container, to be crushed after use
3.	Cup	Cup/glass shape tumbler, one time use plastic container, to be crushed after use
4.	Glass bottle	Container made of glass, can use after sterilization

500, 750 mL, 1, 2, 10 L, etc., in plastic bottles which is made up of PET, the first plastic bottle able to withstand the pressure of carbonated liquids (patented by Hawkins, 2011). Bottled water contains mainly four different ingredients: magnesium sulfate, potassium chloride, and salt alongside purified water on nutrition facts label. Smart water contains calcium chloride, magnesium chloride, and potassium bicarbonate.

2.7 Energy Requirement for the Production of Bottled Water

Energy is required by bottled water throughout its life cycle: from water collection through treatment to package, temperature control, use, and recycle of plastic bottle. It is difficult to calculate a standard total amount of energy required, because it depends on many factors, including location, type of material, distance between manufacturer and consumer (Chesson et al., 2010), water sources etc.; among these only two factors, ways of transport and plastic bottle manufacturing process, mainly contribute to energy requirements (Anable et al., 2006). The PET is embedded with energy, but its conversion into bottles requires additional energy, which comes from natural gas, petroleum, and electricity, 70–83 MJ (thermal) kg^{-1} of PET resin (Gleick and Cooley, 2009) barrel oil having 6000 MJ kg^{-1} (Burton, 1996). Production followed by performance and rendering them into bottles require an additional energy 20 MJ kg^{-1} of finished bottle, thus total energy consumed is approximately 100 MJ kg^{-1}. Total weight of a PET bottle with cap is ca. 40 g. If 40 g PET is required to make 1 L bottle then 4 million tons of PET will be required to produce 100 billion liters of bottled water containers. Most of the manufactures, for example, Nestle, Coca-Cola, etc., have been trying to reduce weight of PET bottles (Tandon et al., 2014).

In summary, energy is required mainly for the production but if distance is more than production, energy become less; while far less energy is needed for the processing, cooling, and treating water.

2.8 Consumption of Bottled Water

Bottled water has been rapidly transformed from niche market into ubiquitous consumer object (Jafee and Newman, 2012); the explosive growth of bottled water is expected to continue. Bottled water has been widely consumed due to convenience and cleanliness (Cidu et al., 2011). The industries are trying to make more thin and lightweight water bottles with clever structural design to increase its consumption. Bottled water of various sizes and volumes predominately made of plastic are produced for public consumptions. In particular since 1990s, bottled water has become a major global commodity available in every corner of the world. From technology perspectives bottled water can be considered a decentralized technology which can distribute water for human consumptions via a portable container, that is, bottle, instead of a pipeline which is required component for transporting water in conventional centralized water infrastructure.

Consumptions of bottled water have sky rocketed in recent years. The global consumption of bottled water reached 230 billion liter in 2010, and has grown faster than 6% per year. In 2016, Mexico recorded a maximum consumption of 67.2 gal or 354 million liter bottled water and the consumption is expected to reach 356 million liters in 2018. By the end of 2017, people are expected to have consumed 391 billion liters. According to "Zion market research" global bottled market value was USD 170 billion and is expected to rise. Thus bottled water consumption has been growing at global level (Muhamad et al., 2011). Earlier bottled drinking water was privileged to high class people, tourists, and highly health conscious people. Therefore, initially bottled market had been crawling at the rate of 3%–4%; but within few years its popularity increased significantly with life style (Sharma and Bhaduri, 2014). People, at present, spend more money on their life style. This tremendously increased the consumption of bottled water. This was reflected in the consumption of bottled water in United States from 1998 to 2016 (Fig. 2.2). In 2007, it was 212 billion liter, which rose to 288 billion liter in 2012, and it was expected to reach 391 billion liter in 2017. Among all countries, Mexico had highest bottled water consumption during the same period (64.5 gal). Asia Pacific had 30% consumption among total consumption of bottled water in the world. The reason behind this consumption is economic growth and life style of people. While, North America and Europe are expected not to grow too much even declination may not be surprising

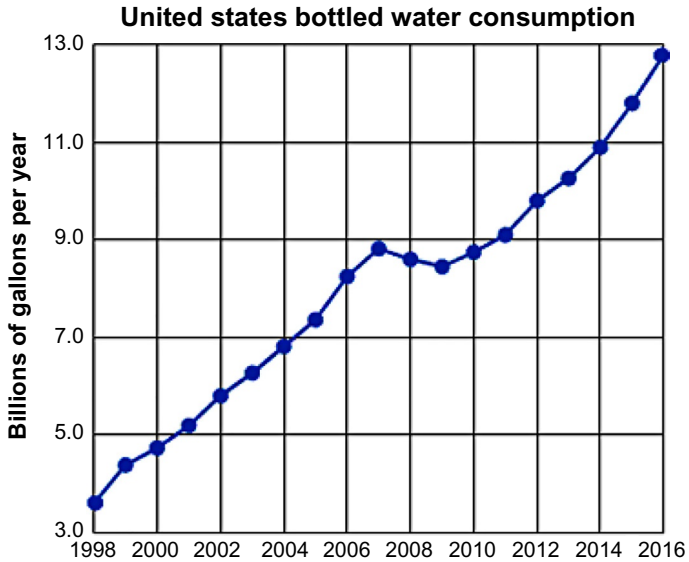

Fig. 2.2 Consumption rate of bottled water in USA. Image taken from geology.com.

for bottled water consumption. Latin America and the Middle East are also expected to witness the robust growth of bottled water market in the years to come. Overall, the reason for bottled water consumption seems to vary. The consumers are now comfortable and ready to use bottled water irrespective of whether it is branded or nonbranded. Some important factors considered are brand, packaged size, shape, convenience, durability, cost, competitive based, and life style, etc. Variety is spice of life, therefore, bottled industries attract people by several ideas. Some companies prefer branding advertisement while others focus on health-based advertisement. The three major reasons behind consumption of bottled water are cost leadership (low), differentiation, and a focus strategy. We can get 300 mL water without glass for Rs. 1. while with glass it will be Rs. 2. Water vendor provides water where water is scarce or there is lack of available drinking water. Water vending refers to many forms of selling water, like water kiosk, tanker, trucks, etc.

2.9 How to Reduce Bottled Water Consumption

Excessive use of bottled water increases environmental problem such as water wastage, pollution, and climate change (Bates et al., 2008; Gornall, 2017). Use of bottled water could be reduced by public

awareness campaign (Samadi et al., 2009) or by showing them movie "how to save water." The drawback of excessive use of bottled water may be explained and necessity and usefulness of tap water for our health may be made understandable (Saylor et al., 2011). There should be campaigns for traditional information based on the grounds that enhance knowledge and understanding of environmental issues that lead to change in behavior.

2.10 Water Quality Indices

Water quality indices are useful tools for the determination of overall quality of water (Tsakiris, 2016; Abbasi and Abbasi, 2012). It is taken by decision makers and stakeholder for water quality issues (Toma et al., 2013). These indices are necessary for the improvement in water quality in which a single figure represents all characteristics of water. The first water quality index was proposed in 1965, in which 10 parameters were included. The most important and widely used water index was developed in 1970. In India, the Bureau of Indian Standards formulated Indian Standard for packaged drinking water and packaged natural mineral water. Water quality has a major impact on human health, (Cemek et al., 2007; Chiarenzelli and Pominville, 2008). Selection of parameters for the water quality indices is a very critical task. Bottled water quality index includes two stages: first one is to test pH and absence of bacteria, *Escherichia coli* and second stage involves determination of five subindices: nitrates (NO^{3-}), nitrites (NO^{2-}), chloride (Cl^{-}), sulfate (SO_4^{2-}), and electrical conductivity at 20°C (Table 2.3). Quality of bottled water is controlled by Food and Drug Administration while tap water is controlled by Environmental Protection Agency.

2.11 Environmental Risk

Bottled water is sold in containers ranging from 500 mL to 50 L. Small bottles are popular in school, office, and in small gathering while big containers are used daily in home, offices, etc. Most of the bottled water containers are made up of recyclable PET plastic. It is a thermoplastic resin, which is 100% recyclable; but rarely, if not always, a small fraction of it is recycled (Boateng and Frimpong, 2013). Definition and environmental cost of transportation of bottled water has been another concern. As the size of the container increases consequent release of carbon dioxide and other hazard may affect climate. Since we are living in the age of "thirsty world," we should take care of water. Furthermore, many people are unaware of the negative effect of PET bottle on human as well as aquatic health (Simon, 2010).

Table 2.3 List of Bottled Water Quality Indices and Their Maximum Allowable Limit

S. No.	Parameters	Unit	Maximum Allowable Limit
1.	*E. coli*	Number/250 mL	0
2.	pH	pH scale	6.5–9.5
3.	Nitrates (NO_3^-)	mg/L	50
4.	Nitrites (NO_2^-)	mg/L	5
5.	Chloride	mg/L	250
6.	Sulfates	mg/L	250
7.	Electrical conductivity (20°C)	μS/cm	2500

It directly affects the climate (Samadi et al., 2009; Yang et al., 2011). We should focus our research on the bottled water consumption (Trumbo and O'Keefe, 2005). For the production of 1 L of bottled water, we need 1.32 L of water; additional 0.32 is used for processing. Therefore, we are consuming extra water, which turns into waste water. Used bottles, which we throw randomly anywhere, may take 1000 years to degrade and even in some cases they release toxic fumes and become litter. Most of the cities in the United States and Canada have banned the use of bottled water due to environmental risk from the bottles. Only one out of five bottles are recycled. Manufacturing of bottled water and destruction of used bottles by incineration pollute air, land, and water, and finally toxic fumes affect the health of the workers. Some bottled water industries uses other than PET bottles, which are nonbiodegradable and get accumulated in land and water. Worldwide fund for nature bracket (WWF) and Greenpeace have warned of the huge environmental footprint of the plastic in which water is packaged. Use of bottled water not only questions our intelligence and affects wallet, but also affects the environment. Our human fish tank gets cloudy since we throw used bottled recklessly. Also PET is nonbiodegradable; it is photodegradable and decomposes into small fragments which absorb toxins and pollute our waterways and soil. These are harmful to human and animals; sometimes toxic antimony, found in PET plastic bottles, can leach from water bottles and cause dizziness, and depression and higher amount can cause nausea, vomit, etc. Plastic bottles and plastic bags are major contributors to pollution rise in beach side. Every square mile of the ocean has more than 50,000 floating pieces of plastics, which disturbs life of ocean creatures. Sometimes they migrate. Only 23% of PET is recycled every year, rest is dumped either on

land or into water stream. Therefore, majority of evidences show that use of bottled water is worse for us, definitely it gives us better option for healthy water but in the other way it causes more and more harm to environment. Sometimes we leave water bottles in car and plastic leaches into water it holds. Thus, production and consumption of bottled water has proven to be wasteful and unsustainable.

Fluoride detection level in bottled water is lower than that of tap water, and only 27% of the tap water samples were reported to contain fluoride at recommended level for optimal dental health (Varela et al., 2015; Butani et al., 2008; Johnson and DeBiase, 2003).

Bottled water companies are wasting resources and exacerbating climate change. Transport is the fastest growing source of greenhouse gas emission and transporting water adds to that.

The number of domestic and foreign tourists is increasing every year, which will increase bottled water sale in the whole world.

Finally, as the temperature increases the compression strength of water bottles decreases. Nowadays, bottled water industry is trying to make thinner and lightweight bottles, thus effects of temperature become more pronounced. Bulging at the bottom affects the functionality of bottles. Thus design also has great impact because its shape affects the bulging.

2.12 Suggestions for the Future

Bottled water does not have any side effect or cause any harm to human body. But the use of bottles affects our environment and energy and also raise the cost by factors such as plastic bottles manufacturing, water packaging, transporting, etc. (Gleick, 2011). It is better to use bottled water only on emergencies like natural disaster or during travel. Use of bottled water is recommended only when pure drinking water is not easily available and water from other available sources may cause harm to us.

Individual local actions such as avoiding bottled water are needed to help curb mounting pollution. If you are satisfied with tap water just boil it before use at home. So, stop buying bottled water and drink freely and easily available healthy tap water. Getting rid of bottled water may help keep our Earth and wallet green.

2.13 Cons and Pros

"Every coin has two sides" positive and negative, similarly, there are some cons and pros of using bottled water. Here we deliberate some cons and pros of using bottled water:

It is the best option to get drinking water, when we are outside. It is more portable, durable, and flexible to use. It is very convenient to carry and therefore very useful especially where the quality of drinkable water is not good. In addition, it is readily available and we can purchase it from anywhere and at anytime according to our need. Most important fact about bottled water is that it does not expire or have a long expiry date, so it can be ideal during disaster or for emergency situations. It has better taste than normal tap water because of treatment processes. Production of bottled water is strictly regulated by food corporation for it to be clean and free of contaminants. It is easily available at grocery stores in various sizes and price, according to the consumer's need.

But process of purifying, bottling, advertising, transporting, and storage increase the actual cost of water. Therefore, it is significantly more expensive than tap water. Generally, plastic bottles contain Bis phenol A, sometimes due to high temperature of the environment this is leached into water, which affects human body. We know that water bottles are mainly made of PET, which is 100% recyclable but most of its part is dumped on the land or into the river/ocean etc. Thus, it creates pollution on land and in water. Fluoride is significantly more likely to be detected in tap water than bottled water, this is the reason for higher prevalence of dental caries in children nowadays. Bottled water costs around 1000 times more per liter than high-quality municipal water. Production of bottled water increases the use of fossil fuels. Manufacturing of plastic bottles consumes more water than it takes to fill your own water bottles.

2.14 To Know

A. In 2009, the small New South Wales town of Bundanoon became the first town in the world to ban the selling of bottled water.
B. In 2012, the town of concord Massachusetts became the first town in the United States to ban the sale of bottled water.
C. Joseph Priestley made his first contribution by dissolving carbon di oxide in water. He discovered oxygen in 1775. Then he developed aerated waters on a commercial scale.
D. First natural mineral water was sold in pharmacies in the 17th century as medicinal water.
E. In 2016, Sikkim (India) announced ban on the use of plastic bottles.
F. Energy waste during bottled water production to consumption would be enough to power 190,000 homes.
G. As per doctor's suggestion, we should drink eight glasses of water per day, in the United States tap water cost equals $0.49 per year but the same amount of bottled water would cost $1400.

2.15 Conclusion

In summary, tap water is healthier, more environmentally sustainable, and equally logically sound than bottled water. Yet many people remain generally unaware of the negative health and environmental impact associated with water, and so, we have to investigate the means to reduce consumption of bottled water. People are comfortably ready to pay for freely available water in form of packaged water without having complete knowledge of it. Advertisements and branding enhance public to use bottled water. Mainly branded bottles are preferred than any other packaged water. Huge amounts of energy are needed for the production to consumptions of bottled water. Treated tap water or natural mineral waters are packaged in PET made plastic bottles, sometimes due to temperature variation, low and high, it may get leached into water, which is toxic to humans. Used bottles never get 100% recycled and therefore, mountains of plastics in most of the tourist places are dumped, which directly or indirectly affect the human as well as aquatic life. Of course water inside the bottle is not as harmful as the container, bottle. Finally, we should minimize the consumption of bottled water to protect our environment, ourselves, animals, aquatic life, etc.

Thus, overall it is concluded that beliefs about health, taste, water quality, life style, the environment all highly boost the consumption of bottled water. Moreover, easy availability of tap water and increasing concern regarding plastic bottles have now become a challenge for industry.

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Conflict of Interest

All authors declare that we have no conflict of interest.

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