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Sri Lankan Bottled Water Industry Overview

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Abstract— Bottled water is drinking water packages in containers. Water is packed mainly in Polyethylene terephthalate (PET) bottles. It has been classified based on the source, price, and size of the water bottle. There are multiple brand names are leading the bottled water market in Sri Lanka. Water bottle manufacturing companies do not produce water, that produces only plastic waste which is a huge environmental problem. To avoid those environmental pollutions, the usage of PET water bottles has to minimize and some reduction methods should be followed.

Index Terms— Bottled water, environmental pollution, purification, waste disposal

1 INTRODUCTION

Bottled water is consumed worldwide as both a matter of necessity and preference [1]. Drinking 'bottled water' is a concept that was introduced to the Sri Lankan psyche in the late 1980s [2]. At the early stages, there was no regulatory framework for manufacturing bottled water and the whole market is on a few water bottling manufacturers' hands. But at that time this did not have a huge demand and mainly consumed by tourists, high health-conscious people and it also hampered by the political uprising that occurred during that period [2]. Local demand for safe drinking water shows significant increment due to several reasons such as the development of the tourism industry, health problems due to unsafe drinking water, improved living standards of people, increasing surface and groundwater pollution, branding, natural disasters, and terrorist activities. Other than that it is becoming a commodity and popular beverage due to providing distance advantages like convenient packaging, consistent quality, and availability. Water produces also follow the models of other expensive beverages, by seeking to establish hierarchy and value through competition and connoisseurship [3]. Nowadays, drinking bottled water consumption is continued to increase rapidly in society. The bottled drinking water as being a healthy alternative to tap water and also it is most effective and its portability is affected by the addition of the higher retile value rather than the other beverage industry. The bottled drinking water involves purification of the treatment process after it is extracted from the source. (Water bottling plant) Globally, there are several types of bottled water such as purified water, mineral water, sparkling water, sparkling mineral water, flavored water, near water and functional water. But the overall market trend moves towards still beverage consumption due to the use of still water for coolers and other bulk formats such as dispensers and pumps [4]. However, in recent years, bottled water come under criticism due to the environmental impacts of groundwater extraction, the energy costs of the plastic packaging and transportation, environmental pollution due to plastic bottle packaging wastes and concerns about water quality and the validity of some marketing claims [2]. There are multiple types of bottled water brands are in the market. The main standards offering institute of the bottled water for Sri Lankan bottled water industry is Sri Lanka Standards Institution (SLS). Some of them are in the SLS standard, but some water bottles are not taken SLS or any other standard. In order to achieve the SLS standards certificate, it is required to process the water source only as spring, tube well or dug well source. It is also required to get the hydro geological survey report, pumping test, chemical analysis of

raw water and finished product, microbiological analysis of raw and finished water, in order to get the SLS standards for bottled water industry [5]. However, there are bottled water available in the market without SLS standards as well as without any quality packaging and information.

The main objective of the article is to give an overall idea about Sri Lankan bottled water industry and its impact on society, economy, and environment. Furthermore, the article suggests some methods to reduce the consumption of plastic bottled water to minimize environmental pollution.

2 DISCUSSION

Currently, Sri Lanka has the drinking water bottled companies which are shared in local and also global market. Mainly there are 181 brands that are registered currently under Food Control Administration Unit (FCAU)in Sri Lanka [6]. Among those registered companies, the leading players which are made a splash at a local, regional and global are: Orzone Mineral Water, Aquarich, Sun Aqua, Pearl Water, Aqua Fresh, Mount Spring Water, American Water, and Kinley are undoubtedly the brand giants of the local bottled water market in Sri Lanka. According to the Food Control Administration Unit records, 174 brands which are manufactured known-mineral water bottled companies in Sri Lanka. There are mainly three importer water bottled companies which are registered under Food Control Administration. Such as : Perrier (France) , ICHI FUJI (Japan) and Acqua Panna (Italy).

2.1 Water Sources

Most of the local bottled water industries are sourced water from dug wells, tube wells, and springs across Sri Lanka. Many springs found in Sri Lanka are active throughout the year to supply a sufficient amount of water for industrial and domestic uses [7]. Other than that tap water or municipal water supply also use as a water source. Artesian water comes from artesian wells (which draws water from confined aquifer) and is not use locally for water bottling. Also, water coming from surface water bodies such as streams, rivers, lakes, reservoirs, lagoons and the sea surround the entire country is not using directly as a water source for water bottling. Bottled water brands that use underground water sources or municipal supplies as water sources defined their bottled water as “purified water” in the bottle labels. Although, most of the labels stated as “mineral water” are sourced water from springs since it contains some dissolved solids like calcium, magnesium, sodium, potassium, silica, and bicarbonates.

According to the local regulations following the food regulations of 2011 under the food act No.26 of 1980, these water sources should have been constructed under the water board regulations and the source water should comply with SLS 614: 2013 standards of Sri Lanka Standard Institution (SLSI). The SLSI also has several quality parameters examine, before giving out the certification. The standards of the water source, the process control and the consistency of the records kept are among them [2]. Ownership of the manufacturing facility and water source is important to get the registration form FCAU as a bottled water plant. If the applicant is not owned by a manufacturing facility and water source, documentary evidence should be provided to prove the legal right to use the land at least for five years [8]. Locally, tap water sourced bottled water plants are not granted registration by FCAU as bottled water manufactures.

The some of the bottled water industrial brand names are tabulated with water purification method in Table 1.

Table 1 . Water sources and purification methods

	Brand Name of the Product	Water type as in the label	Source	Purification/treatment method
1.	Lalanka	Bottled drinking water	Deep tube well	Reverse Osmosis with post and pre-filtering systems with advanced micron & UV sterilization
2.	SMAK	Bottled drinking water	Dug well	Advanced filtration & sterilization
3.	CLEAR	Purified bottled drinking water	Deep tube well	-
4.	Aquafresh	Bottled drinking water	Tube well	Untouched aquifer Not subjected to Reverse Osmosis
5.	SCAN	Purified drinking water	Deep tube well	-
6.	SPRING PLUS	Bottled drinking water	Tube well	Micro & ceramic filtration with UV treatment
7.	Deep Touch	Bottled drinking water	Tube well	-
8.	Sun Aqua	Mineral water	Spring	Sand filter, Carbon filter and cartridge water filters
9.	Mount Spring	Bottled drinking water	Spring	-
10.	Sprout	Organic spring water	Tube well	Reverse Osmosis filtration
11.	Knuckles	Mineral water	Spring	Reverse Osmosis filtration
12.	Express water	Packaged drinking water	Dug well	Multi barrier process
13.	Speed water	Purified mineral water	Underground sources	Advanced micron & UV sterilization
14.	Ozone	Mineral water	Spring	Media filtration
15.	American	Purified water		Aeration, sand filtration, Activated carbon filtration, multimedia and ultra filtration, micron filtration and UV sterilization
16.	SANJO	Bottled drinking water	Tube well	-
17.	CLEAR Spring	Bottled drinking water	Dug well	-
18.	Raja Bojun	Bottled drinking water	Deep tube well	-
19.	Nature’s	Bottled drinking water	Dug well	Standardized filtration process
20.	Frosty	Purified drinking water	Deep tube well	Reverse Osmosis

2.2 Water Purification Methods

Depending on the water source the water quality will be different and need different treatments and purifications to achieve standard levels and to remove contaminants. In Sri Lanka, municipal water treatment is carried out by water board through a series of processes such as aeration, flocculation and clarification, sedimentation, filtration, and disinfection [9]. Even it is treated it needs to purify further to meet SLSI standard specifications to packaged as bottled water. The degraded quality of surface and groundwater resources is a major environmental issue the country is faced with at present [10]. Other than that groundwater in certain areas of the dry zone, there is a high fluoride content and in hard, rocky, alluvial areas, there is a high concentration of iron [10]. In urban over-crowded cities, there is biological contamination of groundwater [10]. So, water obtained from groundwater resources also should purify before packaging.

According to the findings, most of the industries use a multi-barrier system which consists of several treatment stages with initial pre-treatment by settling or pre-filtering through coarse media. This process is important as it provides the basis for effective treatment of water and allows each process stage to treat water to a suitable quality for subsequent downstream processes [11]. Some industries use filtration processes such as cartridge filters, slow sand filters, rapid gravity filters or gravel filters. Gravel filters remove turbidity and algae from the water. Slow sand filters proceed by micro strainers or coarse filtration removes turbidity, algae, and microorganisms [11]. Rapid gravity filters remove turbidity, algae, iron, manganese and also flock from coagulated water. Other than these processes, membrane purification methods such as Reverse Osmosis (RO) also used by some of the industries. It removes water dissolved and undissolved particles, heavy metals, salinity, various microbial and biological contaminants and also the components that are not hazardous to health such as color, odor, taste, and smell in a one-step procedure [12]. Although, this method overcomes issues due to the other purification processes such as high start-up costs, the necessity of electricity, the need for frequent back-flushing and replacement of filterers and membranes [12]. In such a case, the reverse osmosis method is considered as the most efficient purification method to obtain safe drinking water. But mineral water manufacturers do not use RO systems for purification processes since it removes most of the minerals from the water. Even if the manufacturers use the reverse RO process to purify water it is essential to use of disinfection process to inactivate pathogenic microorganisms. Use of Chlorine, UV radiation is the common disinfection method found in local bottled water manufacturing plants. Other than these processes, aeration of the water also doing by some manufactures for removal of volatile organics, carbon dioxide, disinfection by-products, some tastes and odors from the water and it facilitates the efficient mass transfer of oxygen into the water for precipitation of iron and manganese [11].

2.3 Available Sizes And Prices

The prices in stilled price control on bottled water seems like a positive for all consumers. The price controls can cause significant welfare losses, deterioration in product quality, reduction in investment and in the long run, higher prices [13]. The maximum retail prices of available bottled waters are given in the Table 2.

Table 2 . The selling prices of the drinking bottled water in Sri Lanka

	Size	Maximum retail prices per bottle (LKR)
1.	350 ml - 499 ml	26.00
2.	500 ml - 749 ml	35.00
3.	750 ml - 999 ml	40.00

4.	1 ltr - 1.49 ltr	50.00
5.	1 .5 ltr - 4.99 ltr	70.00
6.	5 ltr - 6.99ltr	150.00
7.	7 ltr	170.00

* Bottles larger than 7 liters are not included in the gazette.

The price control has homogenize a differentiable good . The consumer now pays one price across a range of bottled water [14],[15].

2.4 Quality Of The Bottled Drinking Water

The industry started with a few minor companies bottling and selling water without any regulatory framework. The Health Ministry then steeped in making registration under their ministry mandatory to market bottled water. The bottled water registration was introduced in 2005 and was brought into operation in January 2006. The registration of bottled drinking water is valid for three years, during which period the plants are monitored by the authorities. The registration for bottled natural mineral water is valid for one year only. Along with the ministry registration, many companies are awarded SLS certification by the SLSI. The SLS certification is not compulsory. But, companies obtain it for the add image on good hygiene to their brand. The bottled water can be marketed under two categories with the SLS certification (Table 3).

1. The bottles drinking water which has the SLS certification and must comply with the Sri Lanka standard code of practice stated under SLS [2] .
2. The bottled natural mineral water which gets the SLS certification 1038 and must follow the code of practice set under SLS 1021 [2].

Table 3 . The several certified drinking water bottle industry

Producer	Certification
Orzone mineral water	SLS 894, SLS 892 / CFA /BW / 402013 -10 / SLBW
Speed water	SLS 894 / SLSI(ISO9001) SLSI(ISO 22000) / IWA
Pearl water	SLS 894 / CFA / BW / 227/ 2012-10
Sun Aqua	SLS 894 / CFA / BW / 224 / 2016-06 / ISO 22000 / HACCP GMP / SLAB / SGS ISO 9001
Coral water	SLS 894 / CFA /BW / 122 / 2014-09
Aqua fresh	SLS 894 / CFA / ISO 22000 / HACCP / IAD / ISO 19001
Mount spring	SLS 894 / CFA / BW / 21/ 2016-10 / ISO 22000 / HACCP GMP
Knuckles spring water	SLS 894 / ISO 22000
American water	SLS 894 / CFA / ISO 22000 / ISO 9001 / AMBW
Laughs drinking water	SLS 894 / CFA / BW / 41 / 2013-10 / ISO 22000 / ISO 9001 / ISO 14000
Express water	SLS 894 / CFA / BW / 62 / 2013 -07 / ISO 9001
Deep rock	CFA / BW / 15 / 2015 -05
Nikado mineral water	CFA / BW / 70 / 2013-11
Lalanka purified bottled drinking water	SLS 894 / CFA /BW / 116 / 297-04

SLS - Sri Lanka Standard Institute
ISO - International Standard Organization
SLSBW - Member of Sri Lanka Bottled Water Association
CFA - Health Ministry Registration Number
IWA - International Water Association
SGS - System Certification
HACCP - Hazard Analysis and Critical Control Point
GMP - Good manufacturing practice

The Central Environmental Authority was announced new regulations regarding the manufacturing of PET water bottles. According to that, all the PET bottles used for water bottling should be manufactured colorless and materials used for labeling PET water bottles should be made out of non-PVC material. These decisions were taken unanimously to facilitate the PET recycling industry.

2.5 Environmental Impact Of Bottled Water Industry

Sri Lanka produces annually a considerable amount of PET bottle and it is a major portion of end up as plastic waste causing serve environmental problems. In Sri Lanka normally dump millions of tons (approximately) landfill by year. There are several kinds of environmental issues that can be happened related to the PET water bottle industry. Normally when purification of the natural water system several types of chemical is used. After purification of Sourced water, those waste ingredients are added into the environment. Due to that environmental pollution is occurred. In cases of that some important microorganisms, animals are killed due to harmful waste materials. Mostly environmental pollution occurred by wasted plastic sent to the landfill annually and a huge number of plastic bottles used and it ends up in landfills. PET takes up to 1000 years for every single bottle of water to decompose. As well as each bottle emit harmful chemical into the environment. Bisphenol A (BPA), a chemical used to make PET bottles. This chemical gives clear and hard properties to PET. BPA is an endocrine-disrupting which has been proving to be hazardous to human health [16].

As well as after drinking water, PET water bottle throw away by the human. PET bottles are taken thousands of years to degrade. Due to that reason, whatever PET bottles in the environment remain as waste in the environment. Due to that solid waste soil, water and air pollution can happen. When burning of PET bottle CO2 gas is eliminated in the atmosphere. When adding a PET bottle to water systems, will also cause a harmful impact on aquatic organisms. After consumes small particles of the bottle they get killed. Due to the ocean pollution of PET bottles, multiple environmental issues are happening at the alarming rate which can be summarized as, injured to the coral reef, injure to sea animal, depth of sea reduces and then sea pollution occurs.

2.6 Waste PET Recycling

Waste PET bottles are huge environmental impacts in Sri Lanka. To reduce that waste, the most suitable method is recycling. Recycling meaning processing of waste plastic (PET bottles) into an original product or other item or energy [17]. PET consists of the monomer of ethylene terephthalate. Its recycle number code is 1. So, this is a single used plastic.

PET bottle recycling is more practical than other plastics. Because PET bottles are made easier to identify in the recycling sector. When producing PET bottles, bottles produced by using polar fleece materials. Then PET bottles have recyclability properties [17]. In Sri Lanka mostly PET bottles are recycled as a bottle of fiber. Compare to other plastics, PET has excellent thermal disposal (incineration) property. Then it is easy to make

fiber. As well as PET has intrinsic viscosity. It depends on the length of its polymer chains. It is most important to recycling PET to fiber [17]. Life-cycle analysis can be a useful tool for assessing the potential benefits of recycling programmers. If recycled plastics are used to produce goods that would otherwise have been made from new (virgin) polymer, this will directly reduce oil usage and emissions of greenhouse gases associated with the deduction of the virgin polymer (less the emissions owing to the recycling activities themselves) [18].

When recycling PET bottle fair most step is collection of the plastic. The collection of waste PET bottles can be done by several activities such as letting people know about the harmfulness of PET waste, collecting bin situated in public area, camping system holding. After collecting PET bottles, the sorting method is important. Here, bottles with labels are dipped in water to separated. During sorting process cleaning is done. Then that PET bottle was shredded into small pieces. A typical shredder has a series of rotating blades driven by an electric motor, some form of the grid for size grading and a collection bin. Materials are fed into the shredder via a hopper which is located above the blade rotor. The product of shredding is a pile of coarse irregularly shaped plastic flakes which can then be further processed [18].

Then those pellets are extruded out for making fabric. The type of extruder depends on the volume of waste. This is the most common PET recycling method in Sri Lanka. During processing various degradation types happen. The main degradation is hydrolytic, thermal degradation. When PET degradation several things happen as an example of discoloration, reduced molecular weight, chain session, and formation of acetaldehyde and cross-links. Those are easier to make fibers. Recycling is done by plants. But the initial cost of the plant is high. As well as collecting of PET waste bottle is difficult. Then more companies are closed due to the difficulties of collection. Eco spindle and BPPL are the leading PET recycling companies in Sri Lanka [19][20].

2.7 Suggestions To Avoid And Minimize The Waste Generation

- Reduce bottle weights and sizes.
- Used bottles made out of bio-degradable materials - Bamboo bottles can use as eco-friendly, alternative, bio-degradable material. Every person can make these bottles according to their own requirement.
- Placed waste bottle collecting bins in crowded areas.
- Install reverse vending machines to collect waste PET bottles. It accepts empty beverage containers and returns money to the user. After collecting these bottles through the machine, those bottles can reuse or recycle [21].
- Encourage consumers to switch to disposable water bottles and encourage manufactures also to develop environmental friendly products to reduce their carbon footprint.
- Encourage manufactures to purchase back the empty bottles and send them for recycling plants or reform them as new products.
- Implement back programmes that offering support at national and municipal level to ensure the minimum environmental impact from waste bottles.
- New policy implementation regarding plastic waste disposal and continual policy evaluation.
- Use waste plastics to make new products like carpets
- Use empty bottles for creative and functional craft projects without throwing those away.
  Example : make trash bins, use empty bottles to make vertical hanging gardens, bottle cap mosaics, DIY drip irrigators, DIY greenhouses, jewellery stands
- Use of 3R system (Reduce, Reuse and Recycle). This can be done by national level. But to get the focus of the whole community it can be establish municipal level 3R promotional centres and local 3R promotional communities.

2.8 Methods To Reduce The Demand For Bottled Water

- Degradation and depletion of local water resources in Sri Lanka and it result in some diseases like cholera, dysentery, typhoid, diarrhea, kidney diseases are the main issue cause to the development of the local bottled water industry. But a developing country like Sri Lanka can't afford the costly cleaning processes of polluted water hence pollution prevention is the most cost-effective way of control groundwater and surface water pollution.
- The government of Sri Lanka needs to take urgent measures to prevent further pollution water resources by enforcing the existing regulations and to clean up the water bodies in dire conditions, perhaps with private sector participation.
- As being a tropical country Sri Lanka have a vast number of natural fruit drinks and especially several varieties of coconut such as "Thambily", "Kundhira" and "Kurumba". These natural drinks can use as alternative drinks for bottled water..
- Establish rain water tanks to collect rain water.
- Restore the public trust in tap water [22].This can be done by analysing and exploring new tap water quality standards and annually informed to public about the quality of water.
- Adding event water stations to fulfil the requirement of safe drinking water for special events and ceremonies. Also, it can be prohibited to sell plastic water bottles when there is an alternative city portable water supply for events on public properties with more than 100 attendees [22].

Add a tax to the plastic water bottles.

4 Conclusion

According to the obtained knowledge on Sri Lankan bottled water industry, high energy demand and its impact on the environment are the major recognized disadvantages. Under this article, it was concern about the main areas related to the bottled water industry such as leading players, water source, purification methods, sizes, prices, and bottled water quality. Other than that, environmental impact due to waste bottles and PET recycling is clearly obedient to this article. Finally, suitable suggestions to reduce bottled water consumption and minimize waste generation was mentioned.

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