An Economic Analysis of Bottled Drinking Water Industry in India

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Abstract

While safe drinking water is an effective defence against the infection of water borne diseases, a large number of populations suffering from these diseases do not have access to safe drinking water due inadequacy of supply. Private entrepreneurs entered this sector and made bottled drinking water available by supplying various kinds of bottled water. In this study we found that the bottled drinking water industry has experienced a spectacular growth over the past two decades and it has a huge growth potential because of rising demand for safe drinking. High profit margin (217 %) is the main attraction to the entrepreneur to invest in this industry. Health awareness, lack of safe drinking water facilities, rising income, urbanization, migration and rising trend in tourism industries are the major influencing factors of demand for bottled drinking water (BDW). This industry also partially fulfils the demand for drinking water. More than 2 percent of household's demands were met by this industry and many more households (additional 4 percent) coping with BDW during water crisis. Poor households spend around 4 percent of their total monthly household's consumption expenditure on BDW which may have an adverse impact on household because households could have spent this for purchasing other goods. Like other developed counties, a large section of Indian households are shifting from their traditional sources of water to BDW. However, there are some concerns about the quality of BDW. Many cases, BDW contains chemical toxins at more than permissible level that can be harmful for health. Hence, there is an urgent need for appropriate intervention to regulate price, reduce potential harm and improve the quality of water provided by this industry.

Keywords: Drinking Water, Public Failure, Privatization, Development, Public Policy

Introduction

Globally, more than 6000 children die every day because of water borne diseases and additional 300 million children suffer from illnesses caused by lack of safe drinking water

(UNICEF 2004). Economic cost is also huge- annually 40 billion work hours are lost in Africa only to carry water (UNICEF 2004). Although the provision of safe drinking water is an effective defence against the water borne diseases, a large number of populations indeed have no access to safe drinking water. As per UN report (UN Water 2014) 1.1 billion of world populations do not have access safe drinking water. Water borne diseases in developing countries are highest especially in Asia and African countries with widely disseminated epidemics (WHO 2000, Berman 2009).

In India annually 37.7 million populations are fallen ill with water borne diseases. Around 1.1 million children die every year due to diarrhea and 73 million working days are lost due to water borne diseases (Khurana and Sen 2007, UNICEF, FAO and SaciWATERs. 2013). Apart from bacterial infection in water, 10 million populations are at risk due to excess arsenic in the ground water and 66 million Indians due to excess fluoride in drinking water sources from the ground(Khurana and Sen 2007). As a result, water-borne diseases cost an annual $600 million in lost of production and medical treatment (Unicef 2004).

Since Independence Government of India has taken various initiatives for ensuring drinking water to every citizen of India. The first government-installed rural water supply schemes were implemented in the 1950s as part of the government policy to provide basic drinking water supply facilities. In 1972-73 government first impleme nted rural water supply scheme in rural areas- Accelerated Rural Water Supply Programme (ARWSP) to assist the States for providing potable water to the rural population. For better service provision and allocation of water resources India holds three National Water Policy (NWP 1987, 2002, 2012). In national water policy draft, priority was given on allocation of Drinking Water, Irrigation, Hydro-power, Navigation services and then Industrial & other uses. In national water policy 2012, India made major changes with explicit priorities-after meeting the minimum quantity of water required for survival of human beings and ecosystem, water must

be used as an economic good with higher priority towards basic livelihood support to the poor and ensuring national food security. However, services and management of water resources have been transferred to community and or private sector with appropriate public private partnership (PPP) model.

To fulfil the basic demand for drinking water, government implemented supply as well as demand driven schemes. In 1991-92, government implemented technology based supply driven scheme viz Rajiv Gandhi National Water Supply Mission focussed on water quality and adequate supply of water. However, in supply driven approach systems faced the problem of breakdown of the system; quality and quantity of water supply were less than foreseen system. Around 30 percent of the households did not get water in summer (World Bank 2008). In order to provide better services and better quality of drinking water, government introduced a demand driven water supply scheme viz. Swajaldhara scheme under Ministry of Rural Development (Govt. of India 2002). In this scheme, government provide water on cost sharing basis where user need to pay tariff for maintenance and operation cost of this service.

Although this new scheme has some advantage of cost efficiency compared to the earlier supply driven approach scheme but availability of drinking water and quality of drinking water still a big issue. More than 125 million rural populations (15 % of rural) and 19 million (5 % of urban) of urban populations don't have access to improved source of drinking water (NSS 2012)1. Among rural population who can access drinking water, 37.7 percent households don't get sufficient water for 3 months in a year (NSS 2012) and they have been forced to drink unsafe water. As reported by Ministry of Drinking Water and Sanitation, more than 16000 habitants are hit by water contamination across the country. As per government

1 In this study safe drinking water is considered as 'improved source' of drinking water which includes 'bottled water', 'piped water into dwelling', 'piped water to yard/plot', 'public tap/standpipe', 'tube well/borehole', protected well', 'protected spring', and 'rainwater collection'.

data, around 14132 habitations are affected with fluoride, 1991 with arsenic and 1550 have reported with manganese metal, 40 inhabitants with copper, lead and uranium also found in 94 inhabitants.

Thus, there is a huge gap in demand and supply of safe drinking water and government fails to meets the need of safe drinking water. Private sector taking this opportunity and fulfil the gap by providing package drinking water. Since last one decade a large number of entrepreneurs (domestic and foreign) enter into the industry and started business. They supply package drinking water even in India's underserved areas. Private entrepreneurs provide drinking water in two ways- they provide water purifiers device which is designed for small volumes of water. Eureka Forbes, Kent, Tata Swach and Hindustan Unilever's Pureit etc. are some of the common names selling home water filter systems in India. However, many people do not have access to piped water at their homes or lack financial resources to purchase home water purifier. In this case, the companies set up big water treatment plant and sale package drinking water (1 to 20 litter's bottle) to the consumer. Many local entrepreneur set up their plant even in the remote, hard to reach areas where people have no access to drinking water and selling package drinking water. Usually, the pant are set up in a central location from which villagers purchase treated water in jerry cans to be carried home themselves or to be delivered by the water company. In India bottled drinking water (BDW) was introduced in 1965 by Signor Felice Bisleri. Presently this industry has made BDW available in every corner of the country. Many people purchase this water by compromising other consumption because they think that this may save the health care cost later. However, in India, a large number of populations suffering from poverty, deprivation and they are living in the rural areas, having no access to safe drinking water. How bottle drinking water industry fulfilled the need of safe drinking water in efficient and economically sustainable manner? In this context, this study addressing the issues of recent growth of this industry,

market opportunities and its economic and health consequences in India. The specific research questions to be examined in this study are: How bottled water industry growing in India? What is the market size of the industry? What are the major driving forces for higher growth of the industry? How does this industry meet the public needs? And what are the economic and public health impact of this industry? In this study, we examine the above issues by using recent data collected from various sources like Indisstat.com, Annual Survey of Industries (ASI 2004, 2008) in India, Beverage Marketing Corporation, Centre for Science and Environment, Bhabha Atomic Research Centre (BARC) etc.

Data and Methods:

In this study we have use various sources of secondary data on bottled water industries- Beverage Marketing Corporation 2012, Indiastat.com 2014, Annual Survey of Industries(ASI, NIC 2004, 2008), World Bank data on World Development Indicators 2013, National Sample Survey Organization(NSSO 2012) 69^{th} round, Centre for Science and Environment 2003, Bhabha Atomic Research Centre 2015 etc.

Beverage Marketing Corporation (BMC) provides research and consultancy services to global beverage, food and consumer package good industries. BMC started as a data services firm and regularly publishing beverage market data and series of reports on consumption pattern, annual growth rate, production and selling cost of bottled drinking water (BDW) across the countries. In this study we use BMC data on total consumption of bottled drinking water in global top ten countries in the world. Compound annual growth rate is also calculated from BMC data on total consumption in top ten countries during 2007-2012.

To find out the overall growth trend of beverage industries and the relative market share of mineral water in beverage industry, we have used the Annual Survey of Industries(ASI) data during 2004-2010(NIC 2004, NIC 2008). ASI is the principal sources of all industrial

statistics in India. It provides statistical information to assess and evaluate, market structure, changes in growth etc. In this study, we use 5 digit beverage industry data from 2004 to 2010. From 2004 to 2007, we have collected 5 digit beverage industry output of each category (in Rs. Cr)by using NIC 2004 and from 2008 to 2010 we use NIC2008 for aerated drinks, synthetic flavoured, concentration and syrups, mineral water, ice, soft drink, non-alcoholic beverages in beverage industry. Finally we calculated market share of each industries during this periods.

To estimate the percentage of households using bottled water as principal sources of drinking water, we have used NSS 69th round data on " drinking water, sanitation, hygiene and housing conditions in India". By using this data we also estimated the percentage of households using bottled water as alternation sources of water during scarcity of drinking water and what percentage of households copping up from water crisis by bottled water and how much they pay for this has been calculated. This survey collected the information on (i) Principal sources of drinking water including bottled water and whether it is sufficient throughout the year? (ii) How long (month) principal drinking water is not sufficient in a year? (iii) What are the alternative sources of drinking water or how people copping up during scarcity of drinking water? (iv) Price paid for drinking water etc. NSS survey covers all Indian states and union territory comprising 53993 rural and 42155 urban households.

To identify the major factors influencing the demand for bottled drinking water, we developed a time series data base for the following variables: (i) demand for bottled drinking water, (ii) GDP per capita in current US dollar, (iii) Access to safe improved sources of water (percentage of total populations), (iv) Total population, (v) Prevalence rate of diarrhea, (vi) Urbanization rate (vii) Number of tourist visit (domestic and international), and (viii) Renewable internal fresh water resources per capita. To estimates the determinants of demand for bottled for bottled water we used the following simple regression model:

$$\mathbf{DD_{bw} = \alpha_1 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \varepsilon_{it}}$$

Where, DD_{bw} is the measures of demand for bottled water. The explanatory variables are defined in table M1. The term β (β_1 to β_{11}) is the coefficient of the corresponding variables. The constant terms, α control for country characteristics which are presumed to be stable over the period studied.

Table M1: Variable definitions

DD_{bw}	Demand for bottled water
X1	GDP per capita in current US dollar
X2	Access to safe improved sources of water
X3	Total population
X4	Prevalence rate of diarrhea
X5	Urbanization rate
X6	Number of tourist visit (domestic and international),
X7	Renewable internal fresh water resources per capita
ε_{it}	Random disturbance term

Variables for regression model are selected on the basis of a priori economic judgement. We assume that per capita income is one of the influencing factors of demand for bottled drinking water. There are enough evidences in the literature in India that 10 percent of household have no access to improved sources of water. In Rural areas, 47 % households depend on tube well/bore well & 26 % depend on public tape and in urban areas, 61 % depends on pipe water (NSS 2012). But in many parts of Indian ground water is contaminated by heavy metals, chemicals and pesticides. Pipe water is also contaminated by bacteria or other chemical toxicant. So people have no faith on pipe water as well as other improved sources in India. They considered bottled drinking water is the safe sources of drinking water. But people need to pay for it. So when per capita income increases people may shift from traditional sources to BDW. Similarly, access to safe drinking water is another important factor for demand for BDW. Accessibility and availability of safe drinking water may have

adverse relationship with BDW. Total population may also matter for demand for BDW. Similarly prevalence rate of water borne diseases may also an important factor for demand for BDW. Higher prevalence rate of water borne diseases may influence people to change their pattern of consumption of drinking water from their traditional sources to bottled water. Here we use prevalence rate of diarrhea is use as a proxy of water borne diseases because in India 80% of under 5 mortality occurs because of diarrhea.

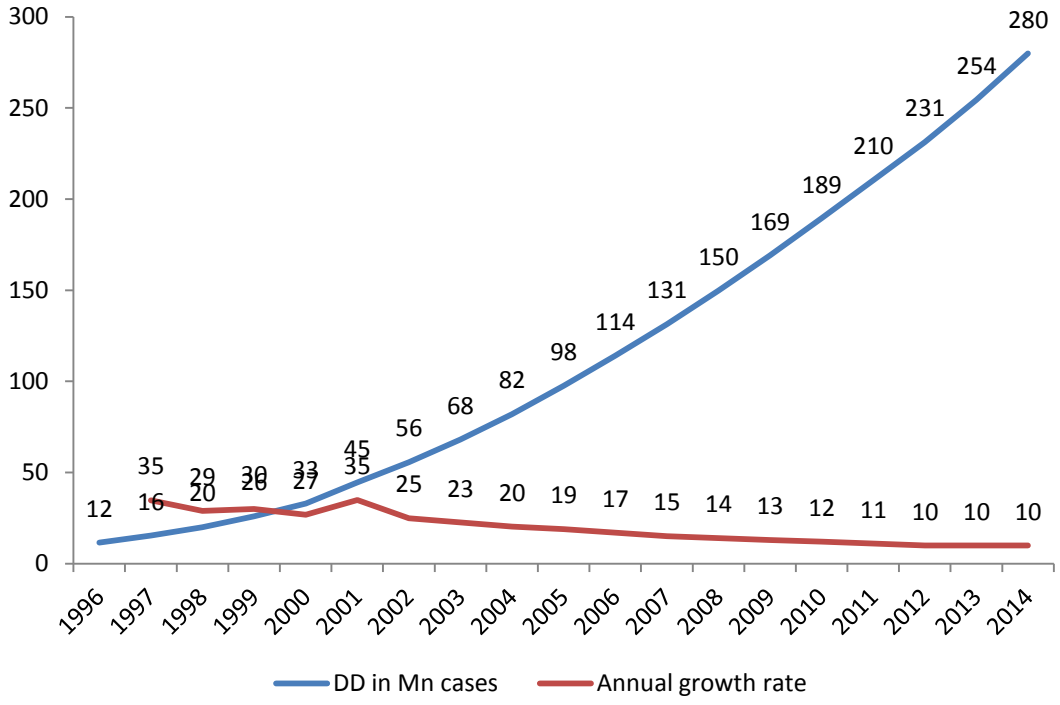
Private participation in investment in water and sanitation could be another influencing factor for enhancing demand for BDW. But its demand is supply induced demand. Supply of BDW creates its own demand. Larger the participation of private sector in investment in drinking water larger the availability and accessibility of BDW that ultimately creates its demand. We have also considered some other variables such as Renewable internal fresh water resources per capita, Literacy rate etc.

For the assessment of health impact of BDW, we have collected clinical data (laboratory test report) from Centre for Science and Environment (CSE), 2003. CSE purchased drinking water bottled randomly from top 17 popular brands and other local brand from Delhi and national capital region during July 2002 to December 2002 and examined at the Pollution Monitoring Laboratory for pesticides. Two bottled from each brands were (34 sample) examined for twelve organochlorines and eight organophosphorus pesticides. Raw water samples from 6 locations from the different plants were also examined. Raw water sample from each water treatment were collected and tested in the same laboratory. In this study, we have also collected clinical test report of bottled drinking water done by a group of scientists of Bhabha Atomic Research Centre (BARC), 2015. BARC collected 90 samples of bottled drinking water from different brands including local less popular brands and examined the sample BDW in BARC's laboratory.

Results:

This study shows that the market for bottled drinking water is growing rapidly. Since 1990s, the growth of consumption of BDW is spectacular. During 1990-2000, annual rate of change of demand for BDW was more than 25 percent (Figure 1). Later on this industry was growing at decline rate and current growth rate is 10 percent. Despite a slow growth(compared to earlier period) and low per capita consumption of BDW, India already entered among the top ten countries interms of volume of consumption of BDW in the world (Table 1). During 2007 to 2012, the compound annual growth rate (CAGR) of the consumption of BDW in India is 13.6 percent whereas world average CAGR is 5.7 percent. USA, China, Mexico Brazil, Indonesia are the top five countries in terms of volume of consumption of BDW. However, the CAGR of BDW is highest in Thailand (18.3%), and then China (14.9%) and India (13.6%) hold third highest position among top ten countries.

Figure 1: Demand for bottled water and Annual growth rate during 1990 to 2014



Source: Indiastst.com

Table1 : Global Bottled water Market in Top 10 Countries: total consumption in Million Gallon and Compound Annual Growth Rate(CAGR)

Rank	Countries	2007	2012	CAGR	Per capita consumption
1	United States	8753.8	9674.3	2	30.8
2	China	4787.8	9577.3	14.9	7.09
3	Mexico	5885.2	7821.5	5.9	65.2
4	Brazil	3621.1	4608.9	4.9	23.2
5	Indonesia	2400.5	4192.1	11.8	17.0
6	Thailand	1533.1	3555.7	18.3	53.2
7	Italy	3100.9	2893.4	-1.4	48.6
8	Germany	2743.2	2826.2	0.6	35.1
9	France	2283.2	2346	0.5	35.7
10	**India**	**899.4**	**1703**	**13.6**	**1.3**
	Top 10 Countries	36008.4	49198.5	6.4	31.7
	Rest of the World	13861.2	16567.4	3.6	
	World Average	**49869.6**	**65766**	**5.7**	**9.2**

Source: Beverage Marketing Corporation, 2013

It has been also seen that the market share of BDW in beverage industry was declined from 24 percent in 2004 to 9 percent in 2010. Major reasons for declining market share is the rising demand for soft drinks and other non-alcoholic beverages (Table 2).

Table2 : Market Share in value of output of Mineral Water in Beverage Industry During 2004 to 2010

	2004	2005	2006	2007	2008	2009
Aerated drinks	30.3	54.4	49.1	36.5	34.7	28.3
Synthetic flavoured concentration and syrups	2.5	3.7	20.5	16.3	6.9	1.3
BDW	**24.0**	**6.8**	**4.4**	**5.6**	**7.1**	**9.0**
Ice	36.8	2.6	1.2	1.7	1.0	0.5
Soft drink	2.3	16.2	13.0	26.1	48.4	52.0
Non-alcoholic beverages	4.1	16.3	11.8	13.9	1.9	8.8

Source: Annual Survey of Industries (NIC 2004, NIC 2008)

What are the major driving forces for spectacular growth of the industry?

The major driving forces of high growth of consumption of BDW are easy availability and accessibility of potable BDW. Supply of BDW creates its own demand. Supply of BDW increased because large number of private in entrepreneur entered into the industry and produced BDW. Major attraction to the entrepreneur is high profit margin in this industry. Table 3, shows that maximum cost of production for producing one litter BDW is Rs.4.61 where water treatment cost is lowest at Rs.0.18 which is around 4 percent of total cost. Highest cost items are bottled (43 % of total cost) and labour & marketing cost (23 %). More than 50 % cost is on bottled and packaging cost (bottled, cap and labelling cost). However, the average selling price is Rs.15. Thus the profit by selling 1 litter of BDW is Rs.10.39 which is 217 percent of cost of production. This high profit margin may attract private entrepreneurs to get into the industry. As a result, a large number of entrepreneurs invest in this industry and produce BDW that ultimately enhances the availability which eventually creates its own demand.

Table 3 : Cost for producing one litter branded bottled drinking water

Cost items	Average Cost(Rs.)	Percentage of cost items
Treatment cost	**0.18**	**3.8**
Cap cost	0.25	5.4
Bottled cost	2.00	43.3
Label cost	0.20	4.3
Carton cost	0.50	10.8
Transportation cost	0.18	3.8
Other cost (ie. Tape, Cese etc)	0.25	5.4
Labour, marketing and Tax etc	1.06	23.1
Total Cost	**4.61**	100.0
Selling cost	**15.0**	
Profit Margin	**10.39**	
Percentage of profit	**217.00**	

Source: Beverage Marketing Cooperation, 2010

There are some other factors that influence the demand for BDW. In Table 4 we have estimated the major determining factor for influencing demand for BDW. It has been seen that per capita GDP is one of the important factor for demand for BDW. Although in our regression model, per capita GDP variable is not significant but it has positive association with the demand for BDW. Access to improved sources of drinking water is also another important determinant of demand for BDW and it has significant impact on demand for BDW and has negative association. This means that if traditional improved sources of drinking water availability increased then the demand for BDW could be lesser. Total number of population also does matter. This means that even though per capita consumption of BDW lesser but if total number of population increase the demand for BDW could be increased. Similarly, prevalence rate of water borne diseases has also significant impact on BDW. Here we used prevalence rate of diarrhea as a proxy of prevalence of water borne diseases because 80 percent of under five children death occurred due to diarrhea which is the most common water borne disease in India. Similarly urbanization—urban population as a percentage of total population has significant impact on demand for BDW. Number of tourist (domestic and international) visited to India has also a positive association with demand for BDW.

Table 4: Major Influencing Factor for Demand for Bottled Drinking Water

Demand for Bottled Drinking Water	**Coef.**	**t-value**
GDP growth	0.038	3.20
Access to improve sources of water	-15.62	-3.88
Total population	5.52	10.93
Prevalence rate of diarrhea	21.51	8.21
Urbanization(Urban population as % of total populations)	5.22	2.17
Number of Tourist Visit	1.96	1.32
Constant	-65.21	-8.16
Number of Observations:18, R^2: 0.76, R^{-2}: 0.75		

Source: Indiastat.com, 2014, World bank: World Development Indicators, 2013

In India, high growth of population along with high urbanization rate influence the demand – supply gap in access to safe drinking water. For this, government allowed private sector to

invest in BDW industry. But how BDW industry meets the public need where large number of population lives below the poverty line? In Table 5, we have seen that 1.84 percent of households use BDW as principal sources of drinking water. In urban areas, 3.07 percent and rural areas 0.84 percent households are using BDW as principal sources of drinking water. It has been also seen that 0.24 percent of poor income quintile households are being used BDW while 5.45 percent of highest income group using the same as principal sources of drinking water. NSS report (2012) shows that availability of drinking water from principal sources is not sufficient throughout the year. More than 3 months in a year, usually in summer season, many households facing scarcity of drinking water. During scarcity, households are being forced to move to other supplementary sources of drinking water. A large number of households are coping up by using BDW. During summer, water scarcity problem is severe in both rural and urban areas. In urban areas, additional 4.77 percent households using BDW for coping up from drinking water scarcity. One percent of rural poor income households and 2 percent of urban poor households also forced to use BDW due to scarcity of water and they spent substantial amount of money for purchasing BDW. In table 6, we have seen that among poor income households average monthly expenditure on BDW is Rs.139.6 which is around 2 percent of total monthly consumption expenditure. In urban areas this amount is higher (Rs. 185) as compared to rural areas (Rs.87). Poor household spent around 4 percent of their monthly household's consumption expenditure where as rich income households spent 2 percent of their monthly consumption expenditure which may have an adverse impact on household economy because household could have spent this for purchasing other goods.

Table 5: Percentage of households using bottled water as a principal sources, supplementary source during crisis, copping by bottle drinking water during crisis

		Rural	Urban	Total
Poor	Principal Source	0.1	0.61	0.24
	Supplementary sources	1.2	2.54	1.65
	Coping household	1.1	1.93	1.41
Middle	Principal Source	0.82	1.34	0.97
	Supplementary sources	1.72	3.46	2.25
	Coping household	0.9	2.12	1.28
Rich	Principal Source	3.07	5.96	5.45
	Supplementary Source	3.11	16.07	13.34
	Coping household	0.04	10.11	7.89
All	Principal Source	0.87	3.07	1.84
	Supplementary Source	1.63	7.84	4.37
	Coping household	0.76	4.77	2.53

Source: Authors calculation from NSS 69th round , 2012

Table 6: Average monthly expenditure per household using bottled water as a principal sources of drinking water

		Rural	Urban	Total
Poor	Monthly expenditure (in Rs.)	87.0	185.0	139.6
	% of household expenditure	2.4	5.6	4.1
Middle	Monthly expenditure (in Rs.)	127.0	228.0	165.8
	% of household expenditure	2.5	4.5	3.3
Rich	Monthly expenditure (in Rs.)	254.0	260.0	259.7
	% of household expenditure	2.1	2.1	2.1

Source: NSS, 69th round, 2012

On the other hand consumption of BDW may have adverse impact on health. Table 7, shows that in BDW reside organchlorine and organophophorus pesticides at more than permissible level. γ-HCH and DDT are two major organochlorine pesticides and Chlorpyrifos and Malathion are the other two organophophorous pesticides resides in BDW which has a high risk of occurring cancer in human body. Except Evian, all other brand in BDW industry

resides these two pesticides level more than 0.001 mg per litter. Maximum level of pesticides resides in Aquaplus(0.052 mg/l) followed by mckdowell (0.042 mg/l), Bisleri(0.039 mg/l), Volga(0.032mg/l) , KwencheR(0.025mg/l) and kingfisher (0.024mg/l).

Table 8 also shows that chemical toxin also found in BDW in Mumbai areas. As per World Health organization (WHO) guideline, maximum permissible limit of bromide and bromate should be not more than 10 mg per litter. However, bromide and bromated level resides in BDW are 28.4 mg per litter and 10.7 mg per litter respectively. On the other hand, minimum desirable level of chlorite and chlorate are 200mg per litter but actual level of these two elements found in sample BDW are 7.1 mg per litter and 20.8 mg per litter which are far lesser than desirable level. Another water test report shows that in Chennai cities, BDW contains E.coli and coliform macro bacteria. As per BIS and WHO guideline, bottled water should be free from any E.coli and coliform bacteria(Table A1). But laboratory test results found that in 100 ml of sample BDW resides 1200 E.coli and 200 coliform bacteria(Table 9).

Table 7: Organochlorine and Organophosphorus pesticide residues in bottled water samples collected from Delhi.

	Organochlorine pesticide(mg/l)	Organophosphorus pesticide(mg/l)	Total(mg/l)
Bisleri	0.003	0.036	0.039
Aquafina	0.001	0.002	0.003
Kinley	0.001	0.006	0.007
Mckdowell	0.005	0.038	0.042
Paras	0.004	0.014	0.019
Bailley	0.008	0.013	0.021
Pure life	0.004	0.004	0.007
Volga	0.006	0.025	0.032
Kingfisher	0.004	0.020	0.024
Prime	0. 003	0.004	0.007
Aquaplus	0.005	0.048	0.052
Hello	0.008	0.014	0.022
KwencheR	0.003	0.022	0.025
Minscot	0.002	0.003	0.005
Himalyan	0.001	0.000	0.001
Catch	0.002	0.001	0.003
Evian	ND	ND	ND

Source: Centre for Science and Environment, 2003

Table 8 : Toxin levels residues in bottled water samples in Mumbai

	BIS		WHO		**Tested results**
	Requirements Limit	Permissible Limit	Requirements Limit	Permissible Limit	**Detected in 58 % tested samples**
Bromide mg/l	No limit set	No limit set	No limit set	10	**28.4(rages: 7 to 73)**
Bromate mg/l	No limit set	No limit set	No limit set	10	**10.7(rages: 0.7 to 43)**
Chlorite mg/l	250	1000	200	1000	**7.1(rages: .7 to 18)**
Chlorate mg/l	250	1000	200	1000	**20.8(rages: 5 to 50)**

Source: Bhabha Atomic Research Centre (BARC), 2015

Table 9: E. coli and Coliform bacteria residues in bottled water samples in Chennai

	BIS		WHO		**Tested results**
	Requirements Limit	Permissible Limit	Requirements Limit	Permissible Limit	
E.Coli count	Must not be detectable in any 100 ml sample		Must not be detectable in any 100 ml sample		**1200 / 100 ml**
Coliform count	Must not be detectable in any 100 ml sample		Must not be detectable in any 100 ml sample		**200/ 100ml**

Source: Water Corporation of Chennai, 2014 (RTI Petition filed by TOI)

Discussion:

This study found that India become one of the top ten countries in terms of volume of consumption of BDW. Although the per capita consumption is lower as compared to other countries. Annual per capita consumption of BDW in India is less than half litter where as the rest of the world average is 8.8 gallon(BMC 2013). Since total population is too large, the per capita consumption does not matter to get the position of high BDW consume counties

because in cumulative terms the volume of consumption is as high as 1703 million gallon per year. There are two possible factors influencing the high consumption BDW and spectacular growth in the industry. The most important factors are socio-demographic and institutional factor influence for rapid growth and secondly industry as well as market itself promotes the high growth. The most important social factor is mistrust with the traditional sources of drinking water about the purity and safety of drinking water. There are lots of evidence that the traditional sources of water like tube well/ bore well, public pipe water is contaminated by either bacterial or metallic as well as chemical toxins(Smith et al 2000, Chakraborty et al 2009, Gogoi 2013). Common people have no faith on these traditional sources of water and preferred to drink bottled water. Other institutional factor is inadequacy of supply of improved pipe water facilities. Government institutions also campaigned about the harmful effect of arsenic, flurried, chemical toxins resides in ground water and suggested for using improved sources of public pipe water. Local government (Panchayet) provide deep tube well facilities or metal and chemical contamination free pipe water facilities to the rural as well as in urban areas. However, these facilities are vastly inadequate to the majority of the household in India only 30 percent household can access the facilities (NSS 2012). As a results majority of household's particularly in rural and in urban slum areas people have been forced to use unsafe sources of water.

Demographic factors like rising trend of urbanization, rural to urban migration are important factor influencing the demand for bottled water. Around 32 percent Indian population living in the urban areas and urbanization is growing rapidly at 2.38 percent annually (CIA 2015). Migration from rural to urban cities is also very important factor for high consumption of BDW. A large portion of migrated population in urban cities, living in slum or unorganised colonies where improved pipe water facilities are not available and because of health reasons finally they preferred to use low cost BDW. Even in many times,

pipe water is available but they do not have faith about the safety standard on it and on the other hand they do not have affordable capacity to installed water purifier device at home and finally they shifted to BDW.

Another interesting phenomenon in this industry is supply induced demand. This means that supply of BDW creates its own demand. Profit margin in this industry is too high (217 %) that a large number of entrepreneurs entered into the industry and produced a large volume of BDW. Currently, 4900 private licensed companies producing BDW and operating their business (CGWA 2015). These producers are produced various kind of BDW (250 ml, 500ml, 1 litter, 2 litters bottled, 20 litters PET jar etc) and they made it available everywhere across the rural as well as in urban areas. These various kinds of product differentiation also create its own demand. For example, tourist, travellers are usually use 1 litter or two litters of BDW. Twenty litters jar drinking water usually demanded in office or households level.

Many unregistered firm also invested in this easy profit making business. They adopted very innovative market strategy for creating the demand of their product. Large producer (branded) spent on advertisement, marketing and transportation. However, small firm(registered or unregistered) usually set up their plant in rural and remote areas where improved pipe water facilities are not available and produce and sell it at low price as compared to other branded companies. Local firm sell 20 litters jar at Rs.15 to Rs.20 in rural areas where as the branded companies sell the same product at Rs.70 to Rs.80. In urban areas also there are price discrimination for same product across the companies. Thus in BDW industry follow monopolistic competition market and there are product as well as price discrimination that influence the demand for BDW.

However, the most important thing is that the common people spent money for having safe drinking water for better health. They think that this current expenditure may reduce the future health care expenditure by avoiding water borne diseases. Even many poor household

spent for this by compromising other consumption. However, the quality or safety of BDW is questionable. This study found that chemical toxin and pesticides detected in BDW in more than permissible level that can be harmful and may have a risk of occurring cancer related diseases. Also some important mineral like chlorate and chlorite is far lesser than the desirable level. One of the major reasons for residing these inorganic chemical toxins in BDW is use of contaminated sources of water for producing BDW. In Delhi and NCR region, BDW contain inorganic pesticides. Most of the water treatment plants in this region are set up in nearby Haryana and Punjab and these two states are the highest user of chemical fertilizer for agriculture. Chemical fertilizer and pesticides partly composed with ground water. All the water treatment plant in this region uses this ground water as source of raw water. After treatment (purification), some of the chemical toxins partly exist in BDW. However, in Mumbai areas many water treatment plant use Ozone for disinfection. During the process of disinfection by Ozone, bromide and bromate are formed and resides in BDW. However, in India, as per BIS guideline, there is no standard measure for these two elements. So there is no question of impurity. But as per WHO guideline, bromide, bromated level should be less than 10 mg per litter and more than this may have adverse impact on health. Institutional policy also allows to grow in this way. There is no proper regulation to control over the industry. New entrepreneur can easily enter into the industry and can exit if intended to go out of the industry.

Conclusion and Policy Implications:

This study concludes that the BDW industry experiencing a spectacular growth over the past two decades. This industry has huge growth potentiality because of increasing demand for BDW. High profit margin is the main attraction to the entrepreneur to invest in this industry. Health awareness, lake of safe drinking water facilities, availability of portable BDW, rising income, urbanization, migration, development of tourism as well are the major influencing

factor for demand for BDW. Two percent of Indian household's demand for drinking water meets by this industry and many more households coping up by BDW during water crisis. Like other developed counties, a large section of Indian households are shifting from pipe water to BDW. However, there are some concerns about the quality of BDW. Many cases, BDW contains chemical toxins at more than permissible level that can be harmful for health.

This creates a policy dilemma- whether government allow private enterprises to continue production in this way or stop them because found it unhealthy? However, in other countries, there is no concerted driven against BDW industry. The country can be benefitted by adopting two alternative approaches: (1) Government can strengthen the public water supply facilities and also ensure the quality of water, and alternatively, (2) government can set up water treatment plant and produced various kind of package drinking water and distributed by charging basic minimum prices that cover cost of production. For example, government of Andhra Pradesh took the initiatives of producing BDW and supply to rural as well as urban household at low price Rs. 2 per 20 litters BDW. In such a case government sponsor low priced BDW will 'crowd out' private competitors or they reduced the price and get normal profit out of it. In addition, government need to regulate price and proper utilization of ground water used by private entrepreneur. Government may also regulate private companies and forced to set up water harvesting plant for raw water that would be environmental friendly and avoid the risk of metallic and chemical contamination. Finally, proper coordination's are needed among various department- BIS, PFA(Prevention of Food Adulteration Act 1954), Central Ground Water Authority(CGWA) and FSSAI(Food Safety Authority of India).

Appendix

Table A1: Drinking Water Standards as per BIS and WHO recommendations

	BIS		WHO	
Substance/ Characteristic	Requirements(Desirable Limit)	Permissible Limit	Requirements(Desirable Limit)	Cause for Rejection
Colour Hazen Unit, max	5	25	5	25
Odour	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
Taste	Agreeable	Agreeable	Unobjectionable	Unobjectionable
Turbidity NTU, max	5	10	1	10
Ph value	6.5 to 8.5	No relaxation	7.0 to 8.5	<6.5 or > 9.2
Total hardness (mg/l)	300	600	200	600
Iron, mg/l	0.3	1.0	0.1	1
Chlorides mg/l	250	1000	200	1000
Residual free chlorine mg/l	0.2	..		
Dissolved solids mg/l	500	2000	500	2000
Calcium mg/l	75	200	75	200
Copper mg/l	0.05	1.5	0.1	1.5
Manganese mg/l	0.1	0.3	0.1	0.5
Magnesium mg/l			<=30	150
Sulphate mg/l	200	400	200	400
Nitrate mg/l	45	100	45	45
Fluoride mg/l	1.0	1.5	1.0	1.5
Phenolic compounds mg/l	0.001	0.002	0.001	0.0002
Mercury mg/l	0.001	No relaxation	0.001	0.001
Cadmium mg/l	0.01	No relaxation	0.01	0.01
Selenium mg/l	0.01	No relaxation	0.01	0.01
Arsenic mg/l	0.05	No relaxation	0.01	0.05
cyanide mg/l	0.05	No relaxation	0.05	0.05
Lead mg/l	0.05	No relaxation	0.05	0.05
Zinc mg/l	5	15	5	15
Anionic detergents mg/l	0.2	1	0.2	1
Chromium mg/l	0.05	No relaxation	0.05	0.05
Polynuclear aromatic hydro carbons g/l	..	..	0.2	0.2
Mineral oil mg/l	0.01	0.03	0	0
Pesticides mg/l	**Absent**	**0.001**	**Absent**	**Absent**
Radioactive materials				
Alpha emitters Bq/l	..	0.1	0.1	0.1
Beta emitters pci/l	..	1	1	1
Alkalinity mg/l	200	600	200	600
Aluminium mg/l	0.03	0.2	0	0.2
Boron mg/l	1	5		
Residual Chlorine mg/l			0.2	>1.0

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