University of Sadat City
Environmental Studies and Research Institute
The4Th International Conference
Environmental for Studies and Research Smart Sustainable Environment
27-29March 2017

Journal of Environmental Studies and Researches (2017), 7(2-D):894-909

A NEW CONCEPT OF WATER RESOURCES MANAGEMENT IN DOMESTIC SECTOR IN EGYPT

Khyal A. Zahra [(1), 1] and Aiman A. Rsheed [(2)]

[(1)] *Researcher, Coastal Research Institute, National Water Research Center, Alexandria, Egypt.Tel.: +201003855109 and E-mail address: khyalahmed@hotmail.com*

[(2)] *Ph. D. of Mechanical Engineering, Basic Sciences Department, Faculty of Engineering, Nada University, Beni Suif, Egypt.*

ABSTRACT:

Due to the limited water resources in Egypt which is coming from outside the borders and the rapidly increasing population growth resulting increasing needs of domestic water, thereby increasing the pressure on water systems and water budget, Egypt has been exposed to serious water crises. The problem is how Egypt can safeguard its water requirements for potable, industry and their agriculture. It is an extremely important to apply innovative philosophies to rationalize the consumption of purified water and to reduce the working of cost effective which is required for treatment and a purification of water. Therefore, the efficient economic use of purified water for domestic sector is a key need for proper water management. This study is concerned to develop a new concept of drinking water distribution to the households by bottles, which this is a share will be deduct from the current water delivered from the purification stations. This concept has been discussed to evaluate and estimate its benefits. The study revealed that the water is entering into homes in Egypt through water distribution network is fully purified coming from purification plants. In this journey, there are water losses due to leakage, irrational use and bad behavior of consumers that the usage of a clean water transferred into non-drinking purposes. Furthermore, the study revealed that the benefits are initially, delay of need to extend the current distribution network and reduction of working costs used in the treatment and purification of water approximately 30% at least. Subsequently, to ensure that the application must be fulfill the international standards of water quality for human drinking. Finally, avoiding the bad effects on human health due to the pollution incident of worn out and gave the current distribution networks and constituents in the most parts of the material that should be changed. The study has recommended an application of this concept at several treatment plants at different parts of the country to evaluate the application for generalization in the nearest future.

***Key words*:** Behavior; Benefits; Consumption; Domestic; Purification; Treatment

[1] *Researcher, Director of Ras El-Bar Coastal Research Station, Coastal Research Institute, National Water Research Center, Postal code 21514, Alexandria, Egypt.*

1-INTRODUCTION:

Water resources management in Egypt is a complex process that involves multiple investors who use water for municipal, industrial water supply and irrigation, hydropower generation and navigation. In addition, the water of the Nile supports aquatic ecosystems that they are threatened by abstraction and pollution. Egypt also has substantial fossil groundwater resources at the Western Desert. A key problem of water resources management in Egypt is the imbalance between increasing water demand and limited supply. To ensure future water availability coordination with the nine upstream Nile riparian countries is essential. The Nile Basin Initiative provides a forum for such cooperation. On the 1990s the government had launched three mega-projects to increase irrigation on "new lands". They are located at the Toshka area (the "New Valley"), on the fringe of the Western Nile Delta, and at the Northern Sinai. These projects all require substantial amounts of water that it can only be mobilized through better irrigation efficiency on already irrigated "old lands" as well as the reuse of drainage water and treated wastewater.

Egypt has a fixed share of a fresh water from the Nile River, which is limited by the agreement between Egypt and Sudan on the 1959, the share of Egypt is 55.5 billion (m^3/year) at Aswan. Therefore, the average annual per capita share of fresh water in Egypt is roughly 600 m^3. This amount is less than 1000 m^3 per capita that is considered as the "*water poverty limit*". This amount is exposed to decrease due to the construction accomplishment of Great Ethiopian Dam. Therefore, Egypt has been exposed to serious water crises.

The agricultural sector (including fisheries) is the highest freshwater consumer, utilizing about 78% of the available supplies, while the domestic and industrial sectors consume 9% and 9.9% of the total supplies [1]. The navigation and energy (i.e. hydropower) sub-sectors are “in stream users”; meaning that they utilize the Nile/irrigation distribution system, but they are not net consumers of the water resources. Drainage water is spilled into the Mediterranean Sea and the desert fringes of the Nile system contribute the water needed to maintain the ecosystem/habitats of the northern Delta/Lakes. Evaporation losses from the 31,000 Km-long water conveyance networks are estimated for about 2.4 BCM/yr as shown on Figure 1.

Drinking water requirements for major urban towns and rural villages have been estimated to be about 4.8 billion m^3/year [2], with average annual growth rate 7.4% [3], where it is an approximately 97% of urban population and 70% or rural population of Egypt relies on piped water supply. The major cities in Egypt (217 cities) currently enjoy full potable water coverage (100%). Rural access to improved drinking water is now 99%. Municipal water is diverted from two sources: surface water which supplies about 83% of total municipal demand and groundwater, which

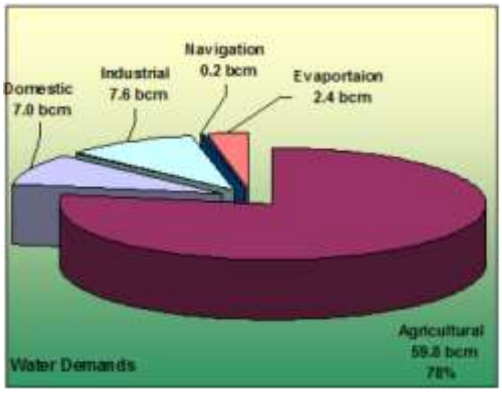

Figure 1: Sect oral water demands
Source: (CEDARE, 2011)

supplies about 17% of total demands. The total municipal demand (drinking water) is calculated to increase by a factor of 1.4 between 2000 and 2017. The total industrial water utilization is expected to increase by a factor of 2.0 through the former period.

Egyptian water sector policies are set by several ministries. The Ministry of Water Resources and Irrigation (previously called Ministry of Public Works and Water Resources) is the oldest ministry in Egypt. Its responsibility is to ensure that the entire users receive enough water. The Ministry of Housing, Utilities and Urban Communities supervises water authorities, which are responsible for the treatment and delivery of water. The Egyptian Environmental Affairs Agency is responsible for environmental affairs and the assessment and monitoring of water use. The Ministry of Health and Population is responsible for analyzing water quality. The Holding Company for Water and Wastewater was founded by decree in 2004, charged with responsibility for financial and technical sustainability to the local Governorate-based utilities. The latter will be addressed separately.

1.1 PROBLEM DESCRIPTION

According to rapidly growing of Egyptian population and changing in cultures and attitudes, it was realized that the country could never depend solely on agriculture. Therefore, to increase the standard of living of its population heavy industry, other industries, services and tourism came to the country's agenda as advanced priorities. The amount of potable water and industrial requirements come up to almost 25% of Egypt's share of the Nile water [3]. Therefore, it is so essential to manage and adjust the actual consumption of domestic sector to face the challenges of purified water supplied to Egyptians, in addition, to allow more people access this amount of purified water adequately. This means the per capita share of the purification cost decreased.

1.2 THE OBJECTIVES

The study objectives are to indicate the necessity of setting a future integrated plan for rational utilization of the available water resources to optimize the actual usage of water, by reduce the losses and maximize the return of each water unit. This concept implies the importance of specifying priorities of the several uses of water per its revenue. Executive strategies for optimum utilization of the available resources including:

a. Changing the distribution pattern to control water use by consumers.
b. Enforcement the implementation of grey water system.
c. Reducing water losses (extreme use and bad behavior) by consumers.
d. Reduce the health budget duo to elimination the contamination in the pure drinking water.

1. MATERIALS, METHODS And DATA COLLECTION

Drinking water supply and sanitation in Egypt is characterized by both achievements and challenges. Among the achievements are an increase of piped water supply between 1990 and 2010 from 89% to 100% in urban areas and from 39% to 93% in rural areas despite rapid population growth; the elimination of open defecation in rural areas during the same period; and in general, a relatively high level of investment in infrastructure. Access to an improved water source in Egypt is recently in practical universal with a rate of 99%. On the institutional side, the regulation and service provision have been separated to some extent through the creation of a national Holding Company for Water and Wastewater on 2004, and of an economically regulator, the Egyptian Water Regulatory Agency (EWRA), in 2006.

2.1 MODEL ASSUMPTIONS

The following assumptions are used in the present model:

- daily consumption of a person = 150 liter/capita/day
- Standard governmental sources.
- Standard sanitation connection.
- A family consists of 5 persons.
- None of a gray water system used before.

2.2 METHODOLOGY

The following activities have been arranged to achieve the study objectives and evaluate the problems of:

a. Changing the distribution pattern to control water use by consumers;

b. Enforcement the implementation of grey water system; and

c. Reducing water losses (extreme of usage and immoral conduct) by consumers, and seeking solutions through the following aspects:

- Compiling the previous related studies.
- Setting a new concept of water distribution management at domestic sector which is reliable for Egypt and the other nations.

2.3 WATER DEMAND FOR THE MUNICIPAL SECTOR

Municipal water or domestic water demand includes formal, informal, urban, and rural sectors at global level This demand includes water supply for major urban and rural villages. The main part of this demand comes from the Nile system and the other comes from groundwater sources. A small portion of the diverted water (about 1.0 BCM) is consumed while the remainder returns to the system. The major factor is affecting the amount of diverted water for municipal usage for the efficiency of the delivery networks. The studies showed that the average efficiency is as low as 50 % and even less in some areas. The cost of treating municipal water can be reduced significantly as the efficiency of the distribution network increases. It is expected to increase significantly due to the population growth as well as due to increase in per capita demand [4]. 5.3 km^3 of water was used for municipal uses (8 percent) and 4.0 km^3 by industry (6 percent). It has been estimated that about 3.5 BCM/year of municipal waste water was being discharged into the Nile and the sea had 0n 2002 an approximately of 1.6 BCM/year (about 45%) which has been treated [5]. Industrial effluents contribute to about 1.3 BCM/year of waste water being discharged to surface waters, only some of which is also being treated.

2.4 OPTIMUM BARGAIN OF THE AVAILABLE WATER

Egypt prepared its first water policy on 1975. Since then, several water policies were formulated to accommodate the dynamics of water resources system, and their objectives and priorities are different. Egypt Water policies are dynamic and they were reformed many times per several aspects; such as water supply availability, using modern techniques, socio-economic impacts, and other relevant factors.

2.5 NEW PARADIGM FOR POLICY FORMULATION

Formulation of Egypt Water Resources Policy for this century requires a major shift from the classical paradigm used in water resources planning and management to a new innovative paradigm. Dynamic interrelationships among the components of water resources system impose the integrated approach on Policy makers. Previous experience shows that when an action or a strategy is planned and implemented in isolation from other components of the system, unsettling impacts are apparent. Using the ecological, social and economic systems as boundary conditions for water resources system is an obsolete assumption. A multidisciplinary dialogue should be adopted the policy formulation process.

2.6 WATER VALUATION

The challenge is to manage water in a way that reflects its economic, social, environmental and cultural values for all its uses. Water should be treated as a basic human right but it should not be provided free of charge. A balance should be struck between pricing of water as commodity and the cost of providing it in a good quality and sufficient quantity. Growing recurrent costs for operation and maintenance of purified water network services and facilities are creating huge budgetary demand in Egypt. In addition, public tap water is heavily funded and has become an economic drain.

2.7 COST RECOVERY FOR OPERATION AND MAINTENANCE

The operation and maintenance costs are the responsibility of beneficially below the delivery point.

2.8 WATER MANAGEMENT PRINCIPLES

Fresh water is a finite and vulnerable resource, essential to sustain life, development and the environment. Since water sustains life, effective management of water resources demands a holistic approach, linking social and economic development with protection of natural ecosystems. Water has an economic value at all its competing usages and should be recognized as an economic good. Principally, it is vital to recognize first the basic right of all human beings to have access to clean water and sanitation at an affordable price. Failure to recognize the economic value of water leads to wasteful and damages to the resource.

Managing water as an economic good is an important matter for achieving efficient and equitable usage, and for encouraging conservation and protection of water resources. Effective management is a links land and water uses across a whole catchments area whether the source comes from surface or groundwater. Water development and management should be based on a participatory approach, involving users, planners and policy-makers at all levels.

The participatory approach involves for raising awareness of the importance of water among policy-makers and the public. It means that the decisions are taken at the lowest appropriate level, with full public consultation and involvement of users taking into consideration the gender aspect, in the planning and implementation of water projects.

2.9 THE DRINKING WATER SUB-SECTOR

The drinking water efficiency is estimated according to the Blue Plan (Epot) such as:

$\mathbf{E_{pot}}$ = V1 / V2, where:

V1 = drinking water volume invoiced and paid by consumer in km^3/year,

V2 = total drinking water volume produced and distributed in km^3/year (drinking water demand).

The indicator measures both the physical efficiency of drinking water distribution networks (loss rates or yield) and economic efficiency, e.g., the capacity of network managers to cover costs through consumer payments.

The total amount of produced potable water on 2009 reached about 9.5 BCM/y. Figure 2 shows that a 83% of this amount is extracted from surface water (Nile and main canals), and about a 16.7% is extracted from shallow and deep groundwater aquifers. Desalination accounts are around 70000 m^3/day.

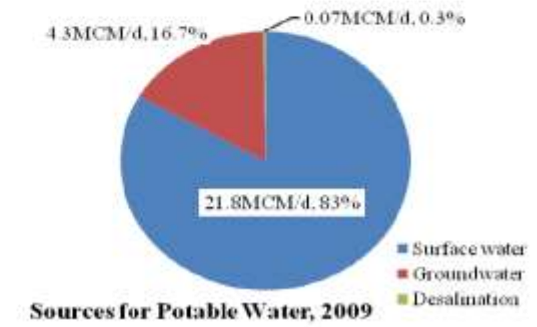

Figure 2: Potable Water Sources
Source: Holding Company for Water and Wastewater (2010)

Figure 3 shows the national progress in water supply services and its associated costs. Potable water production has increased steadily from about 6 BCM on 1997 to 15.7 BCM on 2009. Future plans include the production of about 12 BCM of potable water by 2012 which satisfies the demand till 2030 assuming that total losses will be reduced to 15% by then.

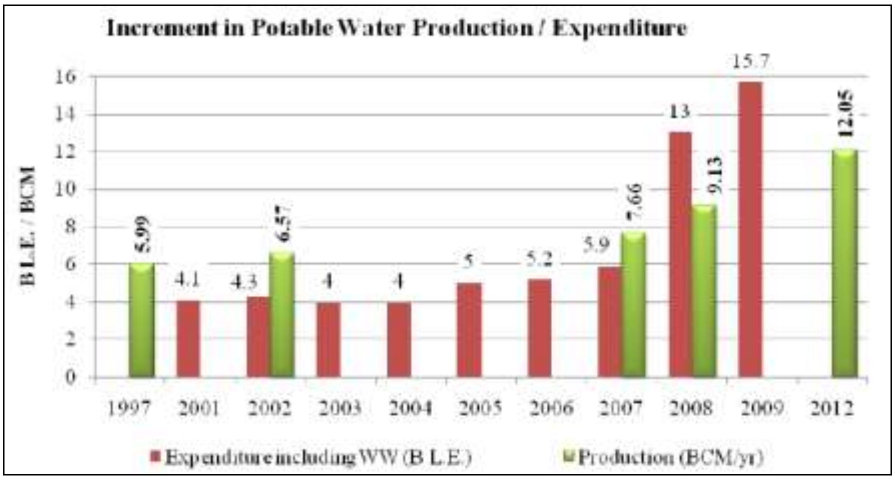

Figure3: Progress in Potable Water Production along with Expenditures for improving potable water and sanitation Services in Billion Egyptian Pounds
Source: The Holding Company for Water and Wastewater (2010) Extrapolated from Nov. – Dec. 2009 Billing Statement.

The drinking water efficiency is first measured for the year 2005 where data is provided by CAPMAS (2007) [6].

Figure 4 shows the volumes of water produced and the percent lost during conveyance for selected governorates where a 25% average loss is envisioned. Maximum losses occur at Fayoum Governorate (about 35%) while minimum losses (10%) occur at Port Said which is usually rated between highest and second highest in average annual income per capita in Egypt.

The case of Alexandria Governorate is presented separately in Figure 5 where data has been more readily available. The figure shows a small, yet steady, decrease in overall losses (network leakage and economic efficiency) between years 2005 and 2008 where the losses dropped from 39% to 35%.

The accumulative annual volume of billed drinking water (V1) on 2005 is equal to 5.395 BCM while the total volume of produced water (V2) has achieved into a 7.179 BCM. Thus, the efficiency of drinking water:

E_{pot} = 5.395 / 7.179 = 0.75.

Furthermore, referring to the billing statements for the last two months on 2009, Figure 6 shows that on 2009:

Epot = V1 / V2 = 6.014 / 8.249 = 0.73

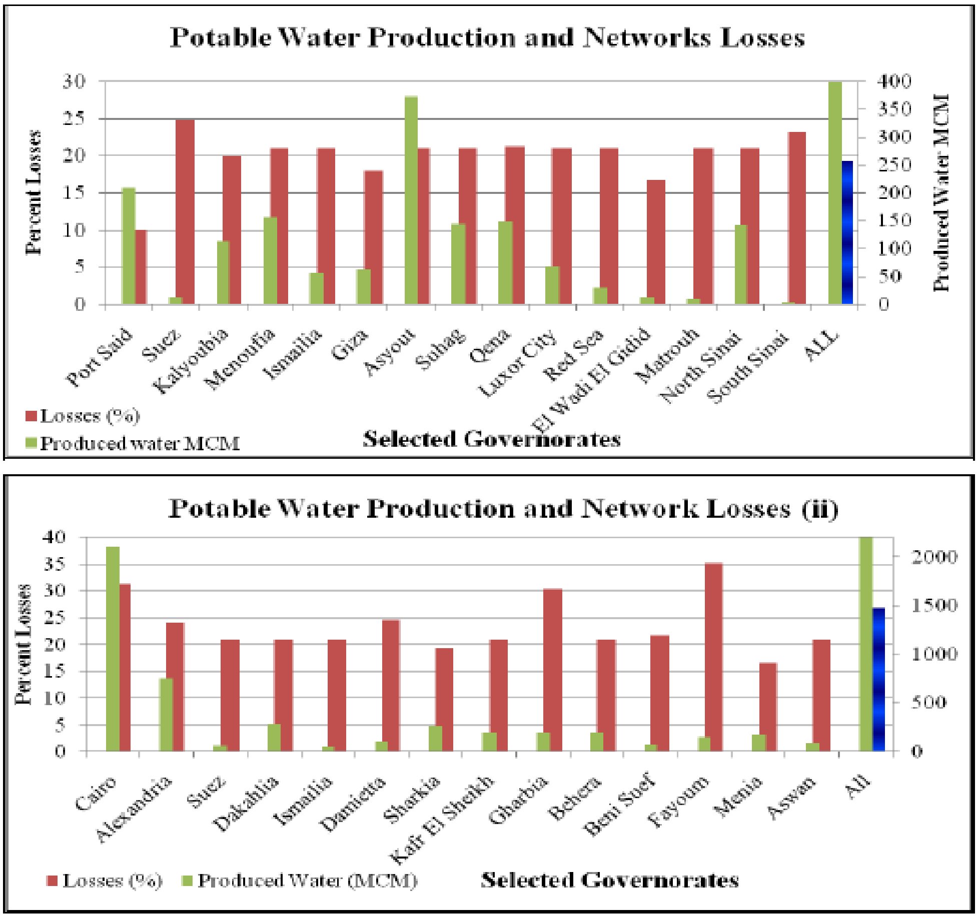

Figure 4: Values for Produced Potable Water and Conveyance Losses for Selected Governorates for the year 2005
Source: CAPMAS (2007)

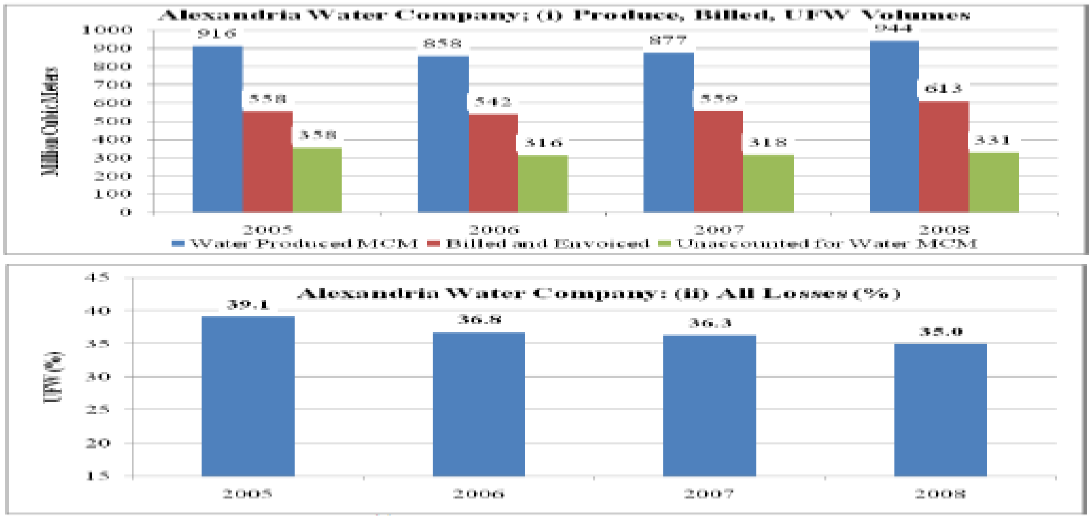

Figure 5: 2005 to 2008 Measured Values for: (i) Produced and Invoiced Potable Water Volumes, and (ii) Total Losses (Conveyance Losses, Uncharged Services, illegal connections) for Alexandria Governorate
Source: Alexandria Water Company; SWITCH Seminar (2009)

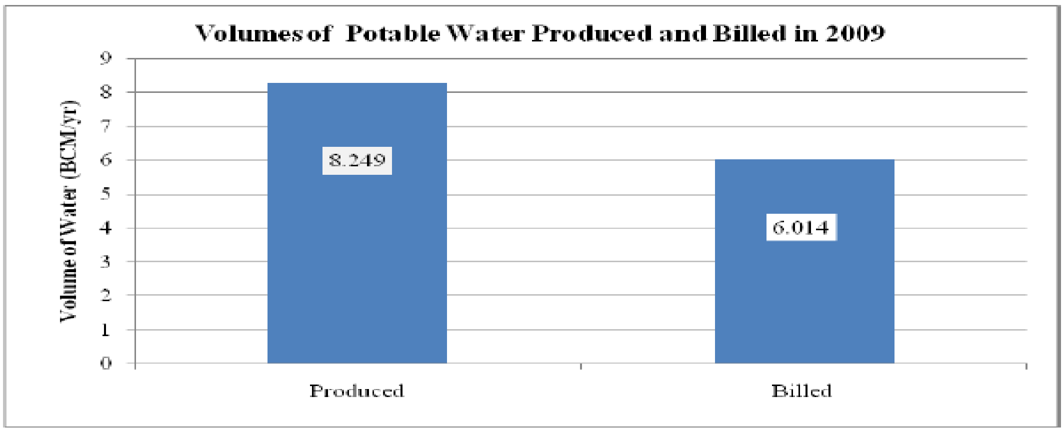

Figure 6: 2009 Measured Values for Produced and Invoiced Potable Water Volumes
Source: The Holding Company for Water and Wastewater (2010) Extrapolated from Nov. – Dec. 2009 Billing Statement.

Table 1 shows that the clear majority (98 percent of households) in Egypt have access to drinking water from an improved source. In most cases, the source is a piped connection in the dwelling itself or the plot (91 percent). Households in the three Frontier Governorates that were covered in the survey are least likely to obtain water from an improved source (85 percent) while households in the Urban Governorates and urban Upper Egypt have almost universal access to an improved drinking water source. Appendix Table A-1 provides information on governorate-level variation in household access to an improved drinking water source.

Few Egyptian households are far from the source from which they obtain drinking water . Most households (93 percent) obtain the water from a source on premises. Most households fetching drinking water from a source outside the dwelling or plot were within 30 minutes of this source .

Table 1 also provides information on the extent to which Egyptian households treat the water they use for drinking. More than 8 in 10 households do nothing to treat their drinking water . Households that treat their water generally use an appropriate method. Overall, 16 percent of households' report using one or more methods to treat the water they drink. Eleven percent of households employ an appropriate treatment method, primarily filtering the water. Households in the three Frontier Governorates and urban Lower Egypt are most likely to report using appropriate treatment methods (19 percent and 17 percent, respectively) [7].

2.9 MUNICIPAL WATER QUALITY

Water quality refers to the chemical, physical and biological characteristics of water. The parameters for water quality are determined by the intended usage: human consumption, industrial use, fishing or agriculture. Water Pollution is defined as the contamination of natural water bodies by chemical (organic and inorganic), physical, pathogenic microbial (as bacteria, viruses and parasites) or radioactive substances. Water pollution negatively affects the poorest's ability to live more healthily and develop their communities, making being poor more expensive.

It is estimated that each year approximately 17,000 children die from diarrhea. One reason is that drinking water quality is often below the standards [8]. Some water treatment plants are not maintained properly and are thus inefficient in removing parasites, viruses and other parasitic microorganisms. On 2009, a study by the Ministry of Health showed that drinking water for half a million people at Asiut was unfit for human consumption [9]. Since 2011, nothing had been done to address the problem. Chlorination systems of wells, which had been installed years ago had failed, because of lack of maintenance, therefore, high levels of bacteria had been detected in the groundwater so that untreated water is provided to the residents.

Table 1 Household drinking water

Percent distribution of households by source of drinking water, time to obtain drinking water, and treatment of drinking water, according to urban-rural residence and place of residence and percent distribution of de jure population by source of drinking water, time to obtain drinking water, and treatment of drinking water, according to urban-rural residence, Egypt 2014

	Households											Population		
			Urban Gover-norates	Lower Egypt			Upper Egypt			Frontier Gover-norates[1]				
Characteristic	Urban	Rural		Total	Urban	Rural	Total	Urban	Rural		Total	Urban	Rural	Total
Source of drinking water														
Improved source	98.8	97.1	99.9	96.4	96.5	96.4	99.0	99.9	98.5	85.0	97.8	98.7	97.1	97.7
Piped into dwelling/yard/plot	96.0	87.6	98.3	87.0	91.7	85.4	93.5	98.2	91.0	69.0	91.0	96.0	87.8	90.9
Public tap/standpipe	0.7	4.6	0.1	4.4	1.4	5.4	2.5	0.7	3.5	4.0	3.0	0.8	4.4	3.1
Tube well or borehole	0.1	0.8	0.0	0.6	0.1	0.8	0.4	0.0	0.7	1.9	0.5	0.1	0.8	0.5
Protected dug well	0.0	0.9	0.0	0.9	0.1	1.2	0.3	0.0	0.4	0.3	0.5	0.0	0.8	0.5
Protected spring	0.0	0.1	0.0	0.2	0.1	0.2	0.0	0.1	0.0	0.0	0.1	0.0	0.2	0.1
Bottled water	2.0	3.2	1.5	3.3	3.1	3.4	2.3	0.9	3.0	9.8	2.7	1.8	3.1	2.6
Non-improved source	1.1	2.3	0.1	3.4	3.4	3.3	0.5	0.0	0.7	5.4	1.8	1.1	2.4	1.9
Tanker truck/cart with drum	1.1	2.3	0.1	3.3	3.4	3.3	0.4	0.0	0.7	5.4	1.8	1.1	2.3	1.9
Other	0.1	0.5	0.0	0.2	0.1	0.2	0.5	0.1	0.8	9.7	0.4	0.2	0.6	0.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Time to obtain drinking water (round trip)[2]														
Water on premises	96.8	89.9	98.5	89.7	93.6	88.4	94.3	98.3	92.2	82.9	92.7	96.9	90.2	92.7
Less than 30 minutes	2.6	7.1	1.4	7.6	5.2	8.4	3.8	1.3	5.2	11.8	5.3	2.6	6.9	5.3
30 minutes or longer	0.5	2.8	0.2	2.5	1.0	3.0	1.8	0.3	2.5	5.1	1.9	0.5	2.8	2.0
Don't know/missing	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Water treatment prior to drinking[2,3]														
Boiled	0.7	0.5	1.0	0.7	1.0	0.7	0.3	0.2	0.3	0.1	0.6	0.7	0.5	0.6
Bleach/chlorine added	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Strained through cloth	0.4	0.3	0.3	0.6	1.0	0.4	0.0	0.0	0.0	0.0	0.3	0.5	0.3	0.3
Ceramic, sand or other filter	13.7	7.4	13.4	10.8	16.4	9.0	7.1	11.0	5.1	19.0	10.0	13.8	7.4	9.7
Solar disinfection	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Let it stand and settle	2.6	7.1	0.9	5.8	3.2	6.6	6.6	4.3	7.8	1.9	5.2	2.7	7.3	5.6
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
No treatment	82.9	85.0	84.6	82.4	78.8	83.6	86.2	84.9	86.9	79.0	84.1	82.6	84.9	84.1
Percentage using an appropriate treatment method[4]	14.4	8.0	14.3	11.6	17.2	9.7	7.4	11.2	5.4	19.1	10.6	14.5	7.9	10.3
Number	11,514	16,661	4,599	13,243	3,293	9,950	10,101	3,480	6,621	231	28,175	43,325	73,022	116,347

[1] Does not include North and South Sinai governorates
[2] Includes households obtaining drinking water from improved and non-improved sources
[3] Respondents were able to report more than one treatment method so the sum of the percentages in the various treatment categories may exceed 100 percent.
[4] Appropriate water treatment methods include boiling, bleaching, filtering, and solar disinfecting.

Table A.1 Improved drinking water and toilet facilities, fr equency of exposure to smoke in the home, and availability of soap and water at hand-washing location

Percentage of households with improved drinking water source, improved, not shared toilet facility, and in which there is smoking in the home, and, among households where the location for hand washing is observed, percentage with soap and water available at the hand washing location, according to governorate, Egypt 2014

	Percentage of households:					
Governorate	With improved drinking water source[1]	With improved, not shared toilet facility[2]	With smoking in home on a daily basis	Number of households	Among households where hand washing facility was observed, percentage with soap and water[3] available at hand-washing location	Number of households with hand-washing location observed
Urban Governorates	99.9	98.7	42.6	4,599	95.1	4,388
Cairo	100.0	98.4	44.0	2,979	95.1	2,828
Alexandria	100.0	99.4	40.1	1,472	95.1	1,417
Port Said	96.9	94.5	37.7	123	96.0	119
Suez	99.8	99.7	43.2	25	98.1	24
Lower Egypt	96.4	84.4	44.4	13,243	92.7	12,716
Damietta	100.0	65.9	30.1	488	98.8	484
Dakahlia	99.9	91.3	37.0	2,133	92.3	2,005
Sharkia	83.1	77.1	44.8	2,414	91.1	2,255
Kalyubia	96.4	92.9	45.9	1,408	82.1	1,244
Kafr El-Sheikh	100.0	92.9	46.1	1,096	94.9	1,090
Gharbia	100.0	96.8	42.5	1,889	95.5	1,868
Menoufia	99.0	95.3	48.2	1,304	97.3	1,302
Behera	100.0	63.0	51.7	2,299	93.5	2,264
Ismailia	99.7	95.8	42.5	214	90.3	205
Upper Egypt	99.0	94.6	45.6	10,101	83.2	9,788
Giza	98.0	94.8	47.4	2,748	93.3	2,679
Beni Suef	99.7	99.2	49.4	935	82.0	929
Fayoum	99.9	92.3	40.1	874	73.4	825
Menya	99.7	96.4	43.6	1,469	73.5	1,456
Assuit	99.9	92.7	44.2	1,332	86.6	1,282
Souhag	99.8	91.1	43.3	1,185	76.3	1,102
Qena	96.0	94.0	50.3	866	84.2	844
Aswan	100.0	98.7	45.2	434	80.6	420
Luxor	100.0	95.1	45.7	258	82.1	251
Frontier Governorates	85.0	99.1	41.3	231	91.4	210
Red Sea	88.5	99.2	48.1	114	91.9	94
New Valley	100.0	98.2	20.8	61	86.5	60
Matroh	61.9	100.0	49.8	57	95.8	56
Total	97.8	90.5	44.5	28,175	89.7	27,102

Table 2: Water Tariffs in Alexandria, per the type of use

S	Type of use	Price		Sanitation charges (% of total bill)
		Quantity (m^3)	Prices L.E. /m^3	
1	Residential	0 – 10	0.23	35
		10 – 30	0.30	
		> 30	0.40	
2	Construction works		0.80	70
3	Religious buildings and social associations(*)		0.42	35
4	Sports club, syndications, political parties, and Embassies		0.15	35
5	Social clubs		1.00	70
6	Small industrial firms, workshops, hospitals, private schools, and bakeries		0.70	70
7	Large scale industrial fims in Burg El Arab		1.00	70
8	Large scale industrial firms in El Amriah and Alexandria		1.50	90
9	Petroleum industrial firms		3.50	70 (If any)
10	Private hospitals, five star hotels, and recreation area		1.15	90
11	Soft drinks firms	-	1.00	70 (If any)

In the village Wardan at North Giza, the water became very dark on 2007. The authorities declared that they were not responsible, claiming that illegal shallow wells or boosters that some residents installed to ensure water availability and pressure, are responsible for the problem. According to the Ministry of Environment, there is a lack of coordination among institutions responsible for monitoring water quality and an absence of a unified system of analysis, techniques and methodologies [10].

The poor exposed to polluted water and air, must be payed the treatment costs of pollution related diseases, or in some cases, and reimbursement the ultimate price: death. Death of the working man or woman in the family grinds down their ability to lift themselves out of poverty and raise their standard of life. In addition, the Environmental Protection Agencies (EPA) standard for drinking water, stated the Maximum Contaminant Level (MCL), which is the highest amount of a contaminant allowed in drinking water supplied by public water system.

However, many challenges remain. Only about one half of the population is connected to sanitary sewers. Partly because of low sanitation coverage about 17,000 children die each year because of diarrhea. Another challenge is low cost recovery due to water tariffs that are among the lowest in the world. This in turn requires government subsidies even for operating costs, a situation that has been aggravated by salary increases without tariff increases after the Arab Spring. Poor operation of facilities, such as water and wastewater treatment plants, as well as limited government accountability and transparency, are also issues.

Currently, there are 59 primary or secondary treatment plants are operating with a total capacity of 6.2 million m^3/day. These sewage treatment plants on 1997 served 30% of the Egyptian population. Via the year 2017, coverage is expected to increase to serve 47% of the population. This is not sufficient to cope with the future increase in the wastewater production from municipal sources. Therefore, the untreated loads reaching water bodies will not decline in the coming years. Because of shortage of wastewater treatment infrastructure, widespread contamination of drinking water supplies, and in turn might be significant episodes of illness.

The sewerage systems serve industrial and commercial activities. So toxic substances as heavy metals & organic micro-pollutants are mainly attached to suspended material most accumulate in the sludge. Improper sludge disposal and/or reuse may therefore lead to contamination of surface and ground water. In general, the bulk of treated and untreated domestic wastewater is discharged into agricultural drains. Egypt faces a rapidly increasing deterioration of its surface and groundwater due to increasing discharges of heavily polluted domestic and industrial effluents into its waterways. Excessive use of pesticides and fertilizers in agriculture also added to water pollution problems. Total coliform bacteria are generally higher than the Egyptian standard of 5000 MPN/100. There is a national policy to maximize the reuse of drainage water by mixing it with canal water resulting in contamination of many irrigation canals from domestic sources. It is important to mention that all drains in Upper Egypt flow back into the Nile. On 2008 the Egyptian Environmental Affairs Agency officially recorded that there was 50 percent more wastewater being discharged into the Nile that is polluted beyond the legal levels than there is discharged within the legal levels.

Dissolved minerals may affect suitability of water for a range of industrial and domestic purposes. The most familiar of these is the presence of ions of calcium and magnesium, which interfere with the cleaning action of soap, and can form hard sulfate and soft carbonate deposits in water heaters or boilers. Hard water may be softened to remove these ions. The softening process often substitutes sodium cations. Hard water may be preferable to soft water for human consumption, since health problems have been associated with excess sodium and with calcium and magnesium deficiencies. Softening decreases nutrition but increases cleaning effectiveness.

DRINKING WATER SUPPLY AND SANITATION IN EGYPT:

Among the achievements are an increase of piped water supply between 1990 and 2010 from 89% to 100% in urban areas and from 39% to 93% at the rural areas despite rapid population growth; the elimination of open latrines at the rural areas during the same period; and in general, a relatively high level of investment in infrastructure. Access to an improved water source in Egypt is recent practically universal with a rate of 99%. On the institutional side, the regulation and service provision have been separated to some extent through the creation of a national Holding Company for Water and Wastewater on 2004, and of an economic regulator [11].

On 2008, the World Health Organization found that 5.1 percent of all deaths and 6.5 percent of all annual diseases and injuries in Egypt are attributable to unsafe drinking water, inadequate sanitation, insufficient hygiene and inadequate management of water resources. This is the way domestic pollution affects water quality heavily depends on the way of disposal of pollutants. Approximately a 65 percent of Egyptian population is connected to drinking water supply and only a 24 percent to sewage services, although the latter percentage is expected to grow rapidly, due to works under construction. The population not connected to sewage systems relies on individual means of excreta and wastewater disposal such as latrines and septic tanks. The domestic wastewater has been spread into soil and groundwater by discharging and collecting wastewater in permeable septic tanks. The domestic wastewater is considered as the main source of pollution of groundwater. It contains many toxic and injurious chemical constituents that have serious effect on public health problems [12].

3. RESULTS And DATA ANALYSIS DISCUSSION

The use of consumed water is divided into three sections:

1. Drinking water and cooking food - According to estimates the individual person consumes 10 liters of water for drinking and food. Thus, in the case of a family of 5 persons, consumption is estimated at 50 liters / day = 1.5 cubic meters / month.

2. General consumption (bathing, washing and cleaning house) - According to Egyptian estimates the consumption = 150 liters/person/day including drinking and food. Thus, consumption per household of 5 persons = 750 liters/day = 22.5 cubic meters/month.

3. Consumption for toilet cleaning (evaporation box) – The amount of water used by conventional flush toilets usually makes up a significant portion of personal daily water usage: for example, it could be as much as 50 liters (13 U.S. gal) liters per person per day if a person flushes his or her toilet five times per day with 10 liters per flush.

Evaporation box has 7-liter capacity. The individual person consumes 3 times = 21 liters/person/day. For a family of 5 persons, consumption = 105 liters/day = 3.15 cubic meters/month. This amount is considered a direct waste which is going from the source to the disbursement. By deleting parts 1 and 3, the consumption = 17.85 m^3/month.

Water distribution is divided into three sections:

1. Water for drinking and cooking – Water distribution by tap water is suggested to be replaced by distribution of handing out closed water bottles to the homes weekly.

2 - Water for public use becomes clean water and not used for drinking, but for washing. The cost of purification will be minimized and the water is still distributed to homes through the current home network.

3. Water for toilets cleaning – The gray water system is constructed by placing the water tank at the top of the buildings. The water is raised and the automatic washing machines are emptied into it, then it is brought back to the toilet flush box and to the sewage pipes.

4. CONCLUSIONS And RECOMMENDATION

1. The cost of production as mentioned that a 17.85 m^3/day purified water is minimized at the purification plants. This amount of water is used and entry to houses through the current distribution network for the family of 5 members.

2 - The amount of water for drinking and cooking become clean according to the international standards and is not possible to spread any diseases to the user. This is done in sealed containers and monitored by distribution vehicles. The cost of selling is the same as the cost of selling current drinking water without any increase.

3 – The gray water system created cost is the responsibility of the housing units and not the state. This enhances the use of water and confirms the lack of waste.

COLLECTION Of Bills Of Consumption

The drinking water is accounted for at its real value according to the total costs of the cost of the containers for the first time, the cost of water, the cost of delivery and the labor force involved in the distribution of the houses. On the other hand, the other water used for washing and bathing is 17.85 m^3/month for the family that it is calculated at the same current price (current tariff). Besides, the quantities consumed and excess of the above quantity are accounted for at a price of 10 times the current tariff.

The study recommends the amendment of the laws and the water policy to handle the changes. This savings are a sufficient to support, renew and replace existing networks without the need to expand the construction of new purification plants. The new usage of water will be without waste due to effective control, with an accurate meter setting for each unit and not for the building as a whole.

One of the advantages of this perception is the access of water to the deprived villages, the slums and the slums in the cities, which reduces the incidence of infectious diseases due to lack of clean drinking water now nowadays due to the lack of clean drinking water networks in the current situation.

ACKNOWLEDGEMENTS

The authors appreciate the assistance of the staff of the Holding Company for Water and Wastewater and encourage this study.

REFERENCES:

- National Planning Institute, Egypt (NPI), (2008), "Egyptian human development report".
- Sakr H., (2007), "Economic efficiency for use of water resources in the Egyptian agricultural sector", *Ph.D. Thesis*, Faculty of Agriculture, Cairo University, Cairo, Egypt.
- Zahra, Khyal A., (2016), "KHYAL MODEL: A New Approach of Optimum Integrated Management and Allocation of Water Resources Tool within Water Scarcity in Egypt*", 7th International Conference on Water Resources and Arid Environments 2016*, 4-5 December 2016, King Saud University, Riyadh, Saudi Arabia
- El-Fellaly, Samy H. and Saleh, Enas Mohammed Abbas, (2004), "Egypt's Experience with Regard to Water Demand Management in Agriculture", *Eighth International Water Technology Conference*, IWTC8 2004, Alexandria, Egypt.
- Ministry of Water Resources and Irrigation (MWRI), (2002), "MWRI/US Agency for International Development", *Agricultural Policy Reform Program: Survey of Nile System Pollution Sources*, September 2002, Report No. 64, p. E-1
- CAPMAS (Central Agency for Public Mobilization and Statistics), Egypt (2007), "Bulletin of Water Resources & Irrigation".
- Egypt Demographic and Health Survey, (2014)
- Shaden Abdel-Gawad, (2007), "Actualizing the Right to Water: An Egyptian Perspective for an Action Plan ", National Water Research Center, Ministry of Water Resources and Irrigation, retrieved on 30/4/2012

- Ministry of Health and Population, (2009), "Drinking water in Asyut unfit for human consumption", Cairo, Egypt, 4 August 2009. Retrieved 23 July 2011]
- United Nations, (2010), " General Assembly; Human Rights Council", Report of the independent expert on the issue of human rights obligations related to access to safe drinking water and sanitation, Catarina de Albuquerque Addendum Mission to Egypt" (PDF). pp. 10–11, 5 July 2010.
- the Egyptian Water Regulatory Agency (EWRA), (2006).
- Easa, A, and Abou-Rayan, A, (2010), **"Domestic wastewater effect on the pollution of the groundwater in rural areas in Egypt**", *Fourteenth International Water Technology Conference*, IWTC 14, Cairo, Egypt. http://www.iwtc. info/2010_pdf/14-02.pdf.