Water Scarcity in the Kingdom of Bahrain - Uncertainty or Lack of Knowledge

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Abstract:

Kingdom of Bahrain is an arid country declared by UN organizations from the Fifties in the last century to be tabulated in water scarcity area. Groundwater is the only natural water source supported by desalination plants. This paper is assessing the present water situation in Bahrain and the perspective of the society to the problem. A survey was conducted through a questionnaire distributed among the students of a national university, University of Bahrain (UOB) from different specialties (science, art, commercial and engineering). Surprisingly, the outcomes indicated that 85% from the involved population in the study of (N=150) were not aware of the serious water problem and thought that since Bahrain as an island surrounded by water (seawater) it should not have a problem. The study urges to divert the uncertainty behavior and the lack of knowledge situation among youth by; 1) strengthening youth's role in water conservation programs, 2)empowering water knowledge for achieving water sustainability, 3) pushing for Public-Private Partnership in development and management of water projects especially, 4) Changing the Attitude and Behaviour of People Towards Water.

Introduction:

The Kingdom of Bahrain is an archipelago of 33 low-lying islands with a total area of 710.9Km^2. The main island, Bahrain, has a capital Manama. Muharraq, is the second largest island located in the northern group, connected to Manama by a causeway 2.4km long. To the east of Bahrain is Sitrah, the third largest island, which is connected to the mainland by another causeway Sitrah, an industrial centre, has an oil reservoir, a port, a power plant, a desalination plant and sand and gravel companies.

The population of Bahrain is estimated at 650,604 inhabitants (CSO, 2002) and expected to be more than 750,000 today due to the ongoing process of giving Bahraini nationality for the expats. The majority of the population is concentrated on the three main islands, namely, Bahrain, Muharraq and Sitrah. Table (1).

The climate in Bahrain is typical of an arid and a semi arid zone with the mean evaporation considerably exceeds rainfall, the annual rainfall is of 70.6 mm, generally speaking the weather is hot and humid. From May to October the maximum average temperature reaches 30° C or above, falling to 20° C or below during winter.

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TABLE 1. POPULATION OF ARAB COUNTRIES IN 1970, 2000 AND 2030 (PROJECTED)

Country and territory	Total fertility rate	Annual growth rate of population (percentage)	Population (thousands)		
			1970	2000	2030
Algeria	2.8	1.8	13 746	30 291	44 914
Bahrain	2.6	1.8	220	640	923
Comoros	6.8	3.5	276	706	1 455
Djibouti	5.9	2.0	155	632	860
Egypt	3.5	2.1	35 285	67 884	99 492
Iraq	5.4	2.5	9 356	22 946	43 099
Jordan	3.7	2.4	1 623	4 913	9 345
Kuwait	4.0	1.7	744	1 914	3 394
Lebanon	2.4	1.4	2 469	3 496	4 730
Libyan Arab Jamahiriya	3.7	2.4	1 986	5 290	8 448

[3] Infant mortality is defined as the death of children under the age of one year.

Table (1) : Population of Arab countries in 1970, 2000 and estimated in 2030
Source : E/ESCWA/SDD/2003/12

Kingdom of Bahrain has been always famous of its natural water resources and springs. Archeologists discovered many evident that many civilizations, such as Delmon and Tylos were living on this land. Bahrain along all its neighbors, Gulf Cooperation Council (GCC) countries (Bahrain, Qatar, Kingdom of Saudi Arabia (KSA), Kuwait, United Arab Emirates (UAE) and Oman) shares a very severe desert environment. Fig (1)

Until the seventies in the last century, Kingdom of Bahrain was satisfying its need for water exclusively by water extraction from groundwater resources[M.,Al Noaimi, 1989].

The major water resources are 1) Groundwater. 2) Desalinating sea water, 3) Treated sewage effluent. Groundwater is principally the only natural water source. In 1928, Mr. Rhoades stated in his report (un published) prepared for Bahrain Petroleum Company (BAPCO); "that water supply of Manama and neighboring come entirely from natural springs and shallow wells dug by hand. Individuals are now having wells drilled for irrigation. The artesian water is of a fairly good quality for drinking purposes, through it contains considerable amount of mineral matter, and most people are engaged in gardening".

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Fig (1): Gulf Cooperation Council (GCC) countries (Bahrain, Qatar, Kingdom of Saudi Arabia (KSA), Kuwait, United Arab Emirates (UAE) and Oman)

been reduced to balance an equal column of salt water. Large withdrawal of sweet water at present would naturally create a flow of salt water from south to north part of the island".

Springs in Forties

Springs in Nineties

Fig (2) : Natural spring waters in Kingdom of Bahrain ; up: in Forties ; bottom: in Nineties.

Source: Hind Al-Qusaibi 1997

In 1997 a newsletter from the center of environmental health in Amman, Jordan stated "11 countries- Bahrain, Cyprus, Jordan, Kuwait, Libyan, Arab Jamahiriya, Oman, the Palestinian Self-Governing Authorities, Qatar, Saudi Arabia, Unites Arab Emirates and republic of Yemen - are already consuming more than 100% of their renewable resources. [CEHA, 1997], Table (2)

Arab world lies far behind on human resources investment. Capacity building and development lacking going aside with most rapid population growth putting more pressure on the available natural resources, especially water as a source of life [Easty, et al , 2001].

Economical development and population growth as well as the mega projects constructed in Bahrain has increased the demand on water since groundwater acts as the only natural water resources. It is expected more water to be extracted from the reservoirs to satisfy the increasing demands for domestics, agriculture and industrial needs which will result in the increase of salinity due to more salt water intrusion from the sea. Fig (3, 4)

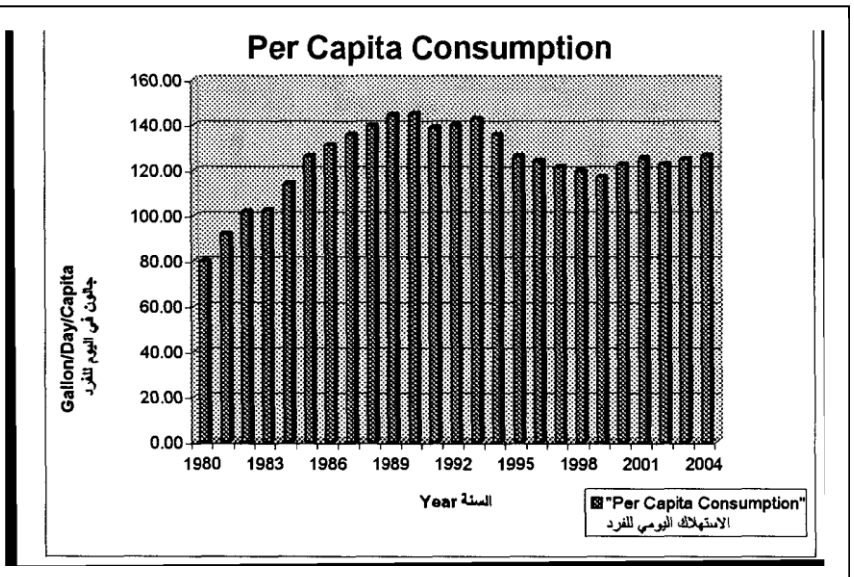
The deterioration of water quality and quantity are very serious not only in Bahrain, but in many neighbors Arab countries. Water stress in the region is a threat to all ongoing socio-economical development in the region.

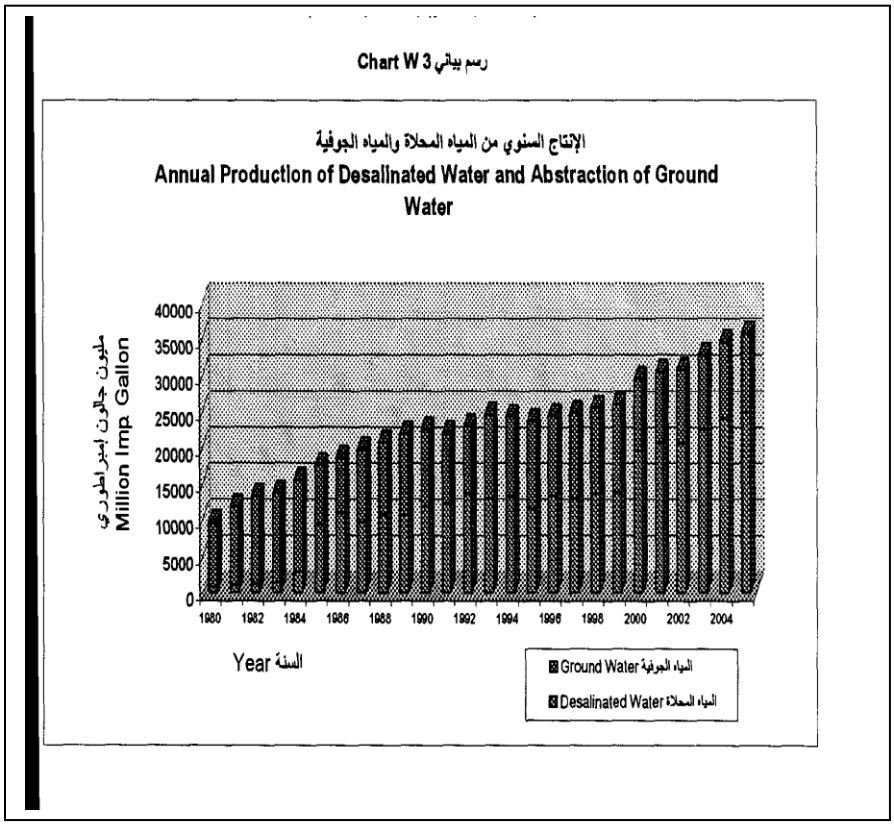
Desalination plants construction should not be considered a remedial action because of its high cost and its destructive effects on marine life.

WATER AVAILABILITY AND USAGE IN THE ARAB WORLD AND NEIGHBOURING COUNTRIES

Country	Annual Renewable Resources (MCM)	Annual Withdrawals		Per Capita ARR 1995 CM	Water Usage %		
		(MCM)	As % of ARR		Domestic	Industry	Agriculture
Algeria	18400	3000	16	655	22	4	74

Table 2: Water availability and Usages in the Arab countries and some neighboring countries.





Up: Fig (3) – Water consumption per capita in the Kingdom of Bahrain ,
Bottom: Fig (4) – Annual Production of desalinated water and abstraction of Groundwater.

Source: Ministry of Electricity and Water – Kingdom of Bahrain

Despite Bahrain's rules and orders concerning water requesting that all water stakeholders and users to control water usages and utilizations as well as water extractions but since none of those issued orders were in the level of an official legislative, the deterioration of groundwater condition (quality and quantity) continued.

UNEP, 2004 reported that "Legislations and baseline data are exist in Bahrain, however, the enforcement of environmental regulations is considered to be a major problem in Bahrain ".

Many of the reasons for low levels of sustainability are related to community issues, such as limited demand, lack of affordability or acceptability among community, perceived lack ownership, limited community education and limited sustainability of community management structures (Carter,Tyrrel and Howsam, 1999)

There is a big gap between what is being done and what should be done un terms of water research in the region (Es'haqi, N.,2007).

The time is very critical to commence in forming a strategy to reach an integrated water management especially by preparing water experts and foster them to handle water future for the nation.

A Simple assessment for the degree of community awareness towards water-concerned topics and for evaluating the strength of the available water education in the formal curriculums in order to measure the available water knowledge would be a good start for recommending the suitable water education empowerment program.

There is a great deficiency in the educational systems in the region. The formal educational institutes are semi-closed on themselves (GCC* educational report, 2002). The lack on the integration between educational institutes and the community harmed greatly the improvement and the progression of the community culturally.

Cognitive studies reveal the importance of coordinating empirical evidence with theoretical hypotheses during scientific discoveries (Klahr & Dunbar, 1988; Zhang, Chen, Sun, & Reid, 2004).

A major challenge for the implementation of the concept of sustainable development is its level-headedness. In order to make the concept operative it must be translated into a set of new action guiding ethical values by individuals and groups (Wiesmann, 1998).

As a consequence, overexploitation, conservation or sustainable use of natural resources have to be understood as ecological expressions of specific, socially and politically defined institutions, norms, values and structures (Pretty, 2003; Veeman & Politiylo, 2003).

Water concepts need to be integrated in the curriculums in the national educational institutes in which this is the place where children and youth are accessible and can be directly approached to raise their awareness towards water concerned issues focusing on their responsibilities for achieving water sustainability.

Study objective and Methodology

Considering the acute water situation in Bahrain, efforts must be made to reach a balance between physical and social aspects of water sustainability. The physical aspects are concerned with the production rate, quality, regulations and governance, i.e. concerned with all the aspects that water decision-makers are responsible of for maintaining both the quality and the quantity of the produced water to reach water security.

The social aspect is concerned with community involvement through capacity building and through raising stakeholders understanding and awareness of the actual water situation using transparent approaches.

The study is to assess water knowledge gained through out the educational life in the formal-governmental schools of the national university students, University of Bahrain (UOB) from different specialties (science, art, commercial and engineering).

No studies were found assessing water knowledge in the community and among the youth. It was not clear at all before this study how much youth and students are involved and concerned with water related issues. It was vital to evaluate the degree of community awareness before concluding or suggesting any recommendations.

Knowledge-creating organizations emerge from a social process that engages participants ‘‘in complex, unpredictable interactions’’ (Sawyer, 2003).

Uncertainty is different from lack of knowledge. Uncertainty means “ not sure” while Lack of Knowledge means “ not knowing”. Knowledge creation is a tool for shifting uncertainty situation to certainty Fig (4).

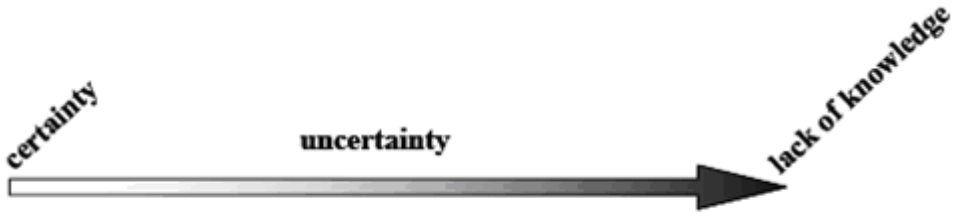


Fig 4: The spectrum of uncertainty is ranging from ‘ certainty ’ to ‘ lack of knowledge’.

A survey was conducted through a questionnaire with 8 closed end questions distributed among the students in UOB from different specialties (science, art, commercial and engineering).

The 8 questions are expected to evaluate the degree of student's awareness towards water issues concerning Bahrain (Appendix). The questions are as follows:

1. Bahrain is facing water scarcity problem?
2. Are you concerned with water shortage within the kingdom?
3. In your opinion, why people do not respond in reducing water consumption?
4. Factors influence the shortage water?
5. Bahrain's water problems?
6. Factors that play strong role in combating water problem in Bahrain?
7. Bahrain's water needs comes from?
8. Water is a valuable natural resource that calls for a responsible management and will dried if not managed?

This paper is discussing two main questions related to the degree of awareness of UOB students taking them as a representing samples for the youth in the society coming from governmental school and studied the formal national schools curriculums. The two questions discussed here are; 1) In your opinion , why people do not respond in reducing water consumption? , 2) Are you concerned with water shortages within the kingdom.

The questionnaire was distributed among 150 students selected randomly. The audience were carefully selected to involved Female and Male of equal proportion.

Results and Discussions:

Although the Arab world in the Gulf hold most of the aspects for achieving sustainability, yet they are considered the most unsustainable region in the world.

Arming through proficiently designed strategies towards nations concerns is a short cut to achieve the drawn goals. Capacity building through tailoring adequate education is thought to be a successful tool for achieving socio-economical sustainability.

Teaching and assessment reveal that teaching is a complex activity that is shaped by the teaching context (Darling-Hammond 2000; Trigwell 2001).

To have a clear complete of the provided water knowledge in the formal governmental school, it was necessary to research science text books from year 1 up to year 12. Surprisingly, not much was found. Almost 7 general topics were found. The topics were covering 1- water cycle, 2- water and earth, 3- water and agriculture, 4- natural resources, 5- environmental protection, 6- Bahrain's weather, 7- water pollution.

The feedbacks from 150 responses were analyzed using statistical software. The first question given to the students was “In your opinion, why people do not respond in reducing water consumption; a) They don’t know – b) Not interested to know – c) No enough advertisements, d) Economical reasons.

The second question was, “Are concerned with water shortage within the Kingdom “, a) Yes – b) No.

Fig 3 (a,b) presents the obtained analysis from the two questions. Surprisingly, in the first question students answered back as follows;

i- 30.71% (They don’t know)
ii- 31.5% (Not interested to know)
iii- 20.47% (No enough advertisements)
iv- 17.32% (Economical reasons)

In the second question, students answered back as follow;

i- 39.37% (Yes)
ii- 60.63% (No)

Sex and gender had no effect on the obtained results, Female and Male students had showed same degree of awareness lacking towards water related topics concerning their country.

Fig (3) Statistical outcome from the 2 selected questions in the distributed survey.
Up (a): In your opinion, why people do not respond in reducing water consumption,
Down (b): Are you concerned with water shortage within the kingdom.

Conclusion and Recommendation

The primary purpose of this study was to assess and evaluate: a) water knowledge among college students in their first year, b) the degree of college student's involvement in water related issues, c) the gaps in the present provided water education in the schools, d) the difference in water knowledge between female and male.

Water situation in the Kingdom of Bahrain is in a very critical stage due to the population and economical growth.

Many approaches have been adapted and implemented for controlling and reducing water consumption in the Bahrain, such as formulating governances, incremental water tariff based on the consumption rate, giving incentives …. Etc. All of the applied approaches for reducing water demand was limited in their effects.

The author as an academic fellow dealing with college students noticed that a large proportion of the students were hearing about the acute water condition in Bahrain as it an issue concerning another planet but not their country. It was cleared to the author that youth and students although are considered as a heavily water consumers, they are playing a great role for the adapted and formulated water conservation strategies of not

being successful in achieving the goals of reducing water demand due to the ignorance of youth.

College students in their first year coming from governmental schools after 12 years studying were the audience study sample. The obtained results in this study shows a critical gap in water knowledge of the college student's resulted from not having adequate water education in the formal schools.

The author urges for a new paradigm for achieving water sustainability, a quick action in endorsing more theoretical and practical water knowledge in the educational curriculums.

Youth must be involved in water management strategies. Youth should feel that they are needed and depended on, and this is very much true because those youth are future decision takers and makers.

Youth should have more societies and organizations dealing with water issues to embrace them in their activities actively.

Integration between educational authorities and all entities, societies, organizations, experts and researchers through formed committees for arranging and preparing water knowledge curriculums. The curriculums should cover theoretical, practical, local, regional and world wide water related topic

The study urges on 1) the need of strengthening youth's role in water conservation programs, 2)empowering water knowledge for achieving water sustainability, 3) pushing for Public-Private Partnership in development and management of water projects especially, 4) changing the Attitude and Behaviour of People Towards Water .

References:

Al-Noaimi, M.A., 1989, The Development of water Use Trends in Kingdom of Bahrain, State of Kingdom of Kingdom of Bahrain (in Arabic).

Carter. R. C., Tyrrel, S.F. and Howsam, P. (1999) Impact and Sustainability of Community Water Supply and Sanitation Programmes in Developing Countries, Journal of Chartered Institute of water and Environmental Mnagement,13,292-296.

Darling-Hammond, L. and Snyder, J. (2000). 'Authentic assessment of teaching in context', *Teaching and Teacher Education* 16, 523–545.

Easty, Daniel C., and Michael Porter. " Rankinn Environmental Performance: A leading Indicator of Future Competitiveness?" In world Economic Forum, The Global Competitiveness Report 2001, New York: Oxford University Press, 2001: 78-101.

Es'haqi, Najat M., Nurturing community participation towards water integrated management, Better Building Workshop, Qatar, 2007

Klahr, D., & Dunbar, K. (1988). Dual space search during scientific reasoning. Cognitive Science, 12, 1–48.

Pretty, J. (2003). Social capital and the collective management of resources. Science, 302(5652), 1912–1914.

Sawyer, R. K. (2003). Emergence in creativity, development. In K. Sawyer, V. John-Steiner, S. Moran, S. Sternberg, D. H. Feldman, J. Wakamura, & M. Csikszetmihalyi (Eds.), Creativity and development (pp. 12–60). Oxford, UK: Oxford University Press.

Trigwell, K. (2001). 'Judging university teaching', *The International Journal for Academic Development* 6(1), 65–73.

Veeman, T. S., & Politiylo, J. (2003). The role of institutions and policy in enhancing sustainable development and conserving natural capital. Environment, Development and Sustainability, 5, 317–332. Vermonden, D.

Wiesmann, U. (1998). Sustainable regional development in rural Africa: conceptual framework and case studies from Kenya. Gegraphica Bernensia African Studies - A14.

Woodruff, E., & Meyer, K. (1997) Explanations from intra and inter group discourse: Children building knowledge in the science classroom. Research in Science Education, 27(1), 25–39.

Zhang, J., Chen, Q., Sun, Y., & Reid, D. J. (2004). A triple scheme of learning support design for scientific discovery learning based on computer simulation: Experimental research. Journal of Computer Assisted Learning, 20(4), 269–282.

Zhang, J., Scardamalia, M., Reeve, R., & Messina, R. (2006). Collective cognitive responsibility in knowledge building communities. Paper presented at the Annual Meeting of American Educational Research Association, San Francisco, CA.

Appendix:

1- Bahrain is facing water scarcity problem;

☐a- Agree ☐b-Moderate ☐c- Disagree

2- Are you concerned with water shortage within the kingdom?

☐ a- yes ☐ b- No

3- In your opinion, why people do not respond in reducing water consumption;

☐ a- They don't know
☐ b- No enough advertisement
☐ c- Economical
☐ d- Not interested to know

4- Factors can influence the shortage drinking water;

i- Climate change
☐a- Agree ☐b-Moderate ☐c- Disagree

ii-Industrial usages
☐a- Agree ☐b-Moderate ☐c- Disagree

iii- Leaks from governments pipes
☐a- Agree ☐b-Moderate ☐c- Disagree

iv- Irrigation habits
☐a- Agree ☐b-Moderate ☐c- Disagree

v-Over use and over abstraction
☐a- Agree ☐b-Moderate ☐c- Disagree

vi- Unfairness
☐a- Agree ☐b-Moderate ☐c- Disagree

5- Bahrain's water problems is due to;

a. Water usages
b. Water recycling

c. Water policies
d. Centralization
e. Transparency
f. Educational programs
g. Poor technology
h. Water abstraction
i. Other: _____

6- which of the following should play strong role in combating water problem in Bahrain;

a. Minimizing water mains consumption
b. Maximizing the use or recycled water
c. Careful plant selection with water consumption
d. Continuous improvement of irrigation system
e. Reuse water where possible
f. Educating the community
g. Leaders should lead by example
h. Institutions development
i. Advocate with landowners for water management
j. Promote/ encourage rainwater catchments

7- Water is a valuable natural resource that calls for a responsible management and will dried if not managed;

☐ a- Agree ☐ b- Disagree

8-To the best of your knowledge, Bahrain's water needs comes from;

☐ a- Sea water ☐ b- Groundwater ☐ c- Treated water
☐ d- Others