Journal of Engineering Sciences
Assiut University
Faculty of Engineering
Vol. 47
No. 2
March 2019
PP. 250–264

THE ROLE OF THE ARCHITECT IN CHOOSING SUSTAINABLE UNITS TO RESTRICT FRESH WATER ABUSE IN NEW URBAN COMMUNITIES - Case study " NEW CAIRO"

Ebtehal Galal El Deen Mohamed

Architecture Department, Faculty of Engineering –Matarya, Helwan University

Received 10 December 2018; Accepted 30 December 2018

ABSTRACT

In terms of the significance of the role of Architects in resolving mega problems in the Engineering practice in the various fields, this study was initiated to investigate the implementation of architectural practice to restrict fresh water abuse by reducing surplus water consumption in new urban communities, where New Cairo was taken as a case study. Primarily, literature was reviewed in the field of water consumption and water resources. In addition, objectives were set, upon which a research methodology was planned. The planned methodology is based on a descriptive analytical approach, where an electronic questionnaire was designed and distributed among a random sample in New Cairo in order to survey their perception to water consumption. Moreover, a statistical analysis was achieved to the random population answers, where graphs and tables were produced using SPSS software. Finally, conclusions were deduced that proposed simple affordable tools in new cities in order to ensure efficient water consumption and reduce the surplus water misuse in new urban communities. This would most probably ensure reliable water supply to the present generation and safeguard it to the future ones. In addition, recommendations for future research and Engineering practice were suggested.

Keywords: Saving water, Water security, Flow rate, New Cairo.

1. Introduction

The role of Architects is of great significance in the Engineering Practice, as they resolve mega problems in various fields, especially in the fields of energy and water consumption so as heat transfer, by introducing simple affordable or tools. Reducing water consumption, as a core of sustainable development integrating ecosystem to human survival, is of great significance. It is one of the most important global challenges and sustainable development, which could be achieved by improving water consumption efficiency.

In the same framework, water misuse created an unprecedented pressure on water resources, as estimates reflected that if practices remain unchanged, the world will face water shortage. (i.e. Estimates pointed out to 40% by 2030. Foreseen is that nine billion are required to be nourished by 2050 by increasing the agricultural productivity by 60%), which consumes 70% of water cycle, globally; meanwhile, groundwater is depleting at a faster rate than recharge, which signposts that by 2025 1.8 billion will suffer scarcity [1].

In terms of the importance of Architects contribution in the Engineering practice, this study was commenced in order to investigate architectural role to reduce surplus water consumption in New Cairo, as a case study representing new urban communities.

The research methodology was designed to be based on a descriptive analytical approach, where data was assembled via a theoretical study by reviewing the previous studies in that field. In addition, it was assembled via an electronic questionnaire that was distributed among a random sample in order to survey water consumption awareness. Moreover, statistical analysis was carried out and graphs so as tables were produced. This paper elaborates the achieved investigation under the subsequent headlines, as follows:

2. Literature review

Many studies were achieved to signpost the importance of the Architect role in contributing in resolving mega problems in the Engineering Practice, in the global, regional and local zones, are involved in water studies. Among these studies are [1-5, 7-13]. This is elaborated as follows:

Regarding the Global Studies [1] , the World Bank published a report in July 2016 about water scarcity impaired by climate change, which would most probably lead to land loss that would mount to 6% of Gross Domestic Product GDP. This will stimulate migration and fuel conflicts. In addition, the combined effects of population growth, rising income and urbanization will lead to an increase in water demand, while supply will remain irregular and uncertain.

- As for the Regional Studies, the 2015 World Economic Forum reflected that the Middle East and North Africa (MENA) [2], Middle East and Egypt in particular, are least prepared to water crises; Fig.1. In addition, the Figure. Indicated that over 60% of the region's population lives in areas of water stress, which is very high, compared to the average world of 35%. This indicates the water stress threatening the region. However, the main challenge to the region development is to take necessary actions in order to navigate in sustainable paths towards safe water. Despite water scarcity, the Middle East and North Africa have the lowest water tariffs in the world; Fig. 2 and the average service cost is twice the average service charge. This might lead to excessive use of scarce water resources. Moreover, economic losses of 4 to 16% of Gross Domestic Product GDP are evident by 2050.
- Concerning the Local Studies, some investigations elaborated that the Nile supplies 80% of water resources, in Egypt, followed by ground water, rain and floods. Agriculture consumes 78% of this water, then drinking water and then industry; Fig.3,4. Such studies emphasized that water scarcity declines the per capita Gross Domestic Product GDP to reach 860 cubic meters by 2002, while it was 1712 m^3 in 1970, 2604 m^3 in 1940. This indicated that Egypt relocated itself from water abundance to sufficient water in 1970. Then it turned to water scarcity at the beginning of 1996 [3]. It is expected to increase its scarcity with upstream dam projects that would influence future local production per capita. World Health Organization documented that basic drinking water services distribution was 99.30% urban and rural 97.64%, in 2015 [4] . However, Cairo's fresh water tariff was 0.05 dollars, while 2% of GDP is expended on other services. This might lead to an excessive water misuse.

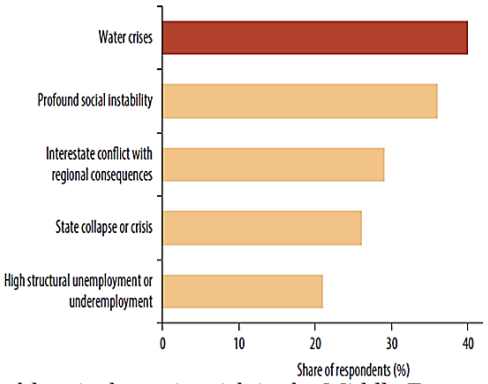


Fig. 1. Water problem is the major risk in the Middle East and North Africa [2]

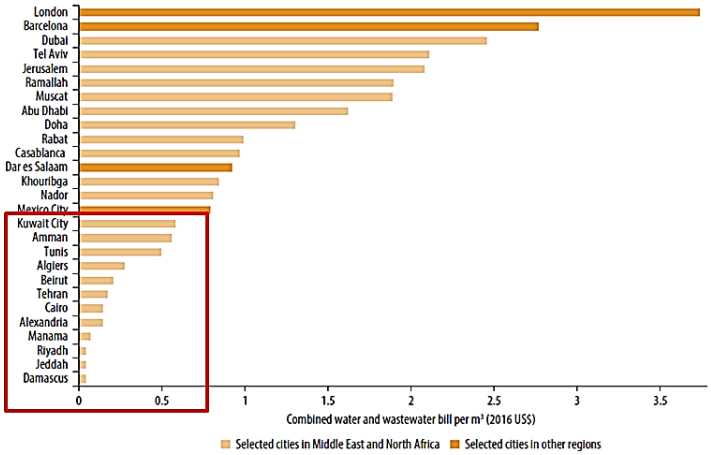


Fig. 2. Water and sanitation Bill per cubic meter/USD, in some selected cities in the Middle East, North Africa and other regions [2]

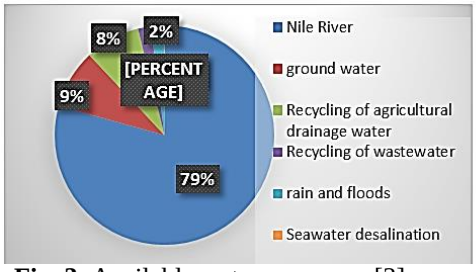


Fig. 3. Available water resources [3]

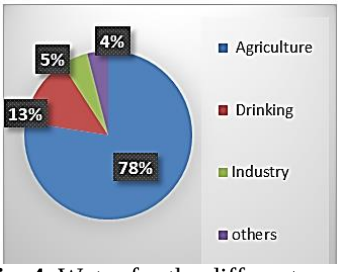


Fig. 4. Water for the different uses of [12]

- An investigation designated for 2 years ago, the consumption of the city with 4 million inhabitants was 1 billion m3/day and now it reached 550 million m3, which is less than 50 L/day after the announcement of Zero Day in Cape Town [5].
- A study signposted that Canada and United States reduced domestic consumption in 1999-2013 to 22% by using water-saving devices [8].
- WordPress investigated the effective measures that can be implemented in the American households to reduce water use in the kitchen and bathroom to replace conventional units with higher wastage modern units or additions easy installation. This decreased water consumption by 45.1%, while savings as a result of the adjustment of certain practices reduced 30.2% [10].

- The Environment Agency of Abu Dhabi with a similar study designated the ratio of 59% of water by changing some practices and tools to save 410 billion L/year [11].

After reviewing the literature, it was obvious that awareness is an important factor in water-saving. Also, many appliances reduced fresh water waste. This would effectively modify the consumption habits and will contribute effectively to achieve water security in countries.

3. Problem definition

The United Nations estimated, in its report [6] on the 11 cities most vulnerable to water disasters, that there is a severe shortage that could be similar to Cape Town by 2025. It further documented that Cairo was the fourth among other countries due to its increased demand, agricultural waste and household waste, where the Nile River is its main fresh water source. Another study was investigating water sufficiency in the Mediterranean countries "Portuguese experience" designated that the use of water-saving devices in bathrooms and kitchens rationalized the consumption to 45%. These devices are influential in addressing water problems [7] .

This encouraged this study to be commenced in order to investigate the implementation of architectural role if any to restrict fresh water abuse by reducing surplus water consumption in new urban communities.

4. Objectives

In recent studies the Arab Forum for Environment and Sustainable Development [13], designated that 75% of a questionnaire tested sample were aware that the per capita consumption rate of Arab countries are the maximum, worldwide. This is attributed to their excessive consumption and lack of rationalization principles [13]. However, no serious effort was initiated. This study was initiated with the main objective of presenting simple and affordable tools to reduce water consumption in new urban communities through the role of architect to restrict fresh water abuse by simple easy adjustments or replacements.

As for the sequential objectives, they are as follows:

- Investigate the role of architects, as community guide that implement the 5R strategy as shown in Fig.5.
- Survey the perception of water problem awareness via a questionnaire; analyze its results to perceive a mental image to the problem and to evaluate the impact of water saving devices and replacements.
- Evaluate behavior changes and replacement of devices to reduce water consumption and preserve them for future generations.

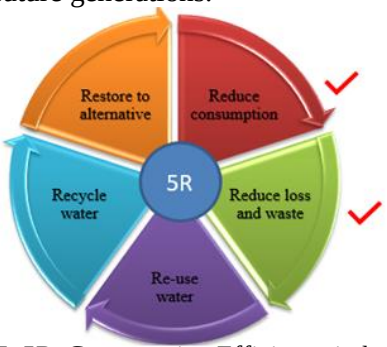


Fig. 5. 5R, Consumption Efficiency in houses [7]

5. Hypothesis

The study put forward some hypothesis, such as:

- Architectures guidance in purchasing taps/mixers in kitchens and bathrooms in new cities contribute in water rationalization.
- New city dwellers have high awareness in choosing taps mixers units due to their high educational level, cultural, economic and lifestyle compared to urban residents.

6. Methodology

This study adopts a descriptive analytical methodology to measure and analyze the role of architectural design mechanisms and community awareness in water consumption rationalization for residents in New Cairo.

6.1. Methods and tools

The implemented tools were:

- A theoretical study to assemble data in the field of water consumption.
- A questionnaire to survey the awareness of a randomly selected population.

Domestic fresh water is distributed into 2 main portions (i.e. Indoor and outdoor), where this study is restricted to the taps and mixers in kitchen and bathroom; Fig.7. On the other hand, domestic consumption is divided into several parts and is represented by water consumption of taps (i.e. washing hands, shower, kitchen, leaks). This mounts up to 46% of daily domestic consumption [14]; Fig.8. In case of manipulating these units through a set of habits and alternatives, they can achieve from 22% to 59% consumption reduction [8-12], [13].

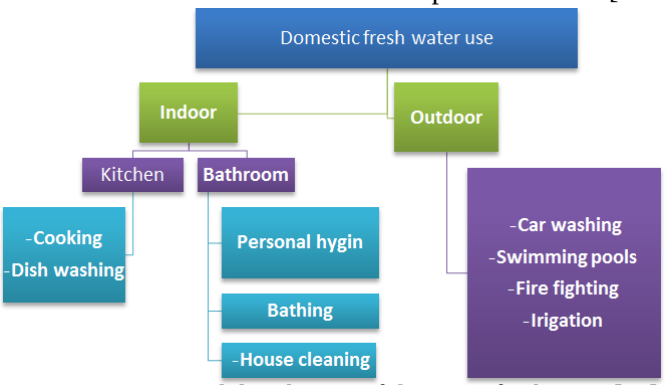


Fig. 7. Uses and distribution of domestic freshwater [15]

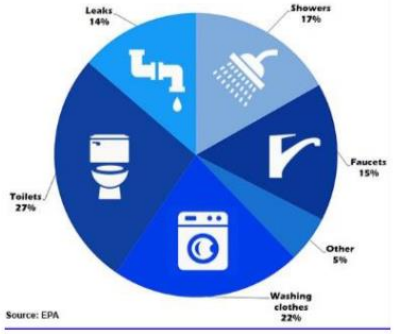


Fig. 8. The proportions of indoor domestic freshwater use [14]

6.2. Investigated units

Mixers and taps were, architecturally, designed to operate with simple smart mechanisms (i.e. units), where their prices range depend on the implemented technology in manufacturing.

Accordingly, this study is focused on investigating a variety of taps that are available on Egyptian market. This is attributed to the fact that the questionnaire will target these units; Fig.9. Tables 1, 2 are provided to compare these types, in terms of operation, cost, advantages and disadvantages.

Fig. 9. Investigated taps and mixers [15]

Table 1.
The basic differences of mixers [15]

	Traditional/ conventional taps.		Sensor/ Motion sense/ Hands-free taps.	Timed turn off
Operating Description	Traditional units are used in homes forever for every design and manufacture, but materials flow control method which is carried out manually.		Units equipped with sensors "infra-red" electronic cut water directly to just keep your hands or anybody , Where Or disable the tap is activated within 0.5 seconds, no drip, which is a common problem with taps.	Operated by pressing a button (or senior) to get running water. Automatically stop after a short period is programmed and adjusted.
Rationalization in water compared to conventional [16]	washing dishes	20%	65%	
	teeth	15%	80%	
	Hands	10%	70%	
Cost	-		In the long term, the cost would be less by up to 20% compared to conventional. Unlike the initial purchase price.	
Maintenance	-		40% less than Maintenance of traditional mixers.	
Flow	10 L/min average flow		6 L/min average flow	
Unit price in local market	Least Unit price in the local market starts from 100 L.E.		Starts from 6000 Egyptian pounds according to manufacture and used materials.	Starting from 24 USD (i.e. 430 L.E.) according to manufacture and materials used.
Availability in market	available		available	Unavailable but by shipping
Examples				
Additional advantages	Economic in terms of initial cost		• Hygenic as it work without touching • Ensure the closure in the case of self-forgetfulness • Longer lifespan than traditional	
Disadvantages	• Leakage • Could flood the place.		• Need for maintenance units for IR/temp • Easy for pets to open • Priced higher than conventional in terms of initial cost	

Table 2.
Differences between complementary units fitted to mixers [15]

	Aerator Faucet	Separated sensors	One touch units
			
Operation	Air filters are pressure small attachment ventilation flow regulators placed at tap end or introduced into ventilation device. It is an orifice that separates flow into small streams to entrain air into water to reduce water supply with water pressure, unnoticeably. However, tub fill takes longer time. Its price is small compared to the rationalized water cost. [17]	It is similar to sensor. The only difference is that it comes in 1 unit separate from the mixer. It is installed at the end of the tap to operate sensor and then open or close the water.	It works in a simple manner to sensor unit, but without any additional links. When the arm is moved, water flows and stops when left.
Maintenance	It is easy to maintain and needs periodic cleaning to avoid its blockage. It needs seconds to be fixed.	Its maintenance is relatively complicate, like sensors due to the electrical part (battery) in it.	It is easy to maintain; easy to replace spare parts and more economic.
Average unit price [18]	Its price starts from 4 $ (70 L.E), according to the used material.	Its price starts from 35 $ (600 L.E), according to the used material.	Its price starts from 8 $ (150 L.E), according to the used material.
Availability in the local Market	Available in the market	Available by shipping	
Installation			
Advantages	The unit features consist of • Gyro ball joint to allow tilting. • -Nozzle with a dual function with normal airflow or pull-down spray pattern to provide stronger spray. • Maximum flow rate is 7 l/min.	• All units are received upon shipping • No leakage. • Useable by pets • Keep the tap perfectly clean.	• Easy to use • Do not need experts or technicians.
General advantages	• Don't specialists as it is easy to replace in minutes. • Electrical connections that do not need special maintenance. • Easy to use • Reduces waste • Fits kitchens and bathrooms • Suitable for children and seniors • It is economic due to clinging to used mixers. • Fit most designs and forms of available mixers on the market		
Disadvantage	• Not available on the market and the alternative is shipping from international markets with all its consequences. • Lack of information or advertising. • IR unit needs an energy source or battery.		

The rate of using tap water in kitchens and bathrooms depends on several factors that were considered in the questionnaire. These factors encompass the following:

- The more the number of living individuals in the unit, the more the consumption rate and dishwashers reduce water consumption up to 25% [19]
- Seasonal consumption varies. Winter consumption increases due to the waiting of warmer water to wash face, hands, ablution, bathing and dish washing. Accordingly, the questionnaire encompassed an inquiry about utilization rates from March to June 2018 [20]
- Receiving advice from an architect/ecosystem consultant during the construction process might affect the consumption rate.
- The economic level of the residence will affect their purchasing power to modern saving units.

The present study focused on the role of architect, the economic level and education level in selecting mixers and taps to raise their performance with/without being replaced. In addition, a statistical analysis was performed to survey the random population perception to water saving units and the role of architects to implement design mechanisms to enhance the water consumption behavior.

The electronic forms were distributed among a random population in the different segments of society. After receiving the answers, a statistical analysis was carried out using SPSS 22 ***"Statistical Package for the Social Sciences"***.

7. Results and discussion

The questionnaire was received from the random sample (100 participants) within 3 months. Responses were analyzed, in terms of three key phases:

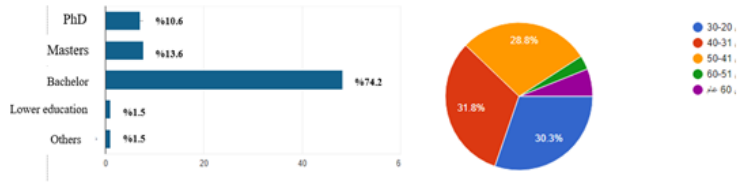
- During the First Phase, the participants were categorized into categories.
- All through the Second Phase, calculations were achieved to determine the rates of flow, based on the received questionnaire responses.
- Throughout the Third Phase, a statistical analysis was achieved by implementing SPSS "Statistical Package for the Social Sciences" to study the effect of the variables.

7.1. Phase 1: categorizing the participants

The participants were categorized to find out the following:

- The age of 30 to 40 and 20 to 30 recorded the major portion of participants (i.e. 60%), which indicated that it is evident that their unawareness is doubtful, and their experience is questionable.
- Academic level (i.e. Bachelor) designated 75% of the participants, Lower education designated 1.5%.

Fig.10 provides the proportions of age groups, housing category, average family members and educational level of participants.

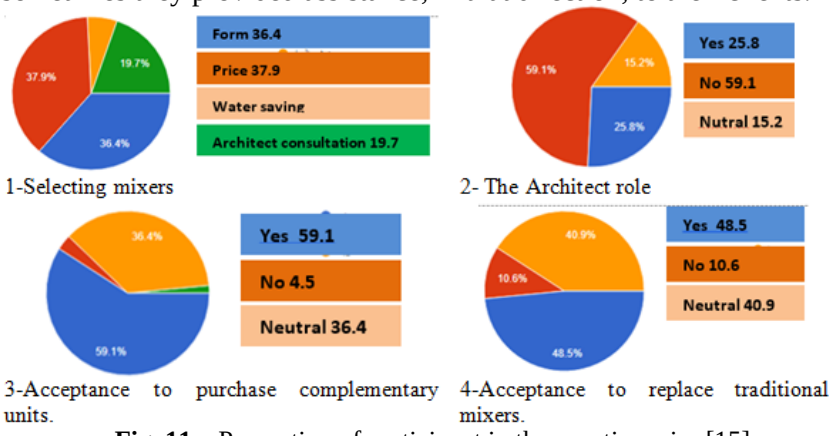


1. Participants educational levels 2. Age distribution of participants

Fig. 10. Participants' distribution [15]

Based on the results, it was clear that:

- The traditional taps or mixers with manual flow control were 98% of all devices in services area for the tested sample.
- 60% of the sample confirmed the absence of any consultant architect or interior designer in selecting or advising of water saving mixers.
- The sample indicated that the cost then shape dominates their choice. Only 10% were concerned about water consumption.
- With the aid of the electronic questionnaire responses, videos and info graphs, the importance of water conservation was elaborated to indicate:
- 90% of the participants confirmed the importance of water scarcity problem data which covered in the form, and the importance of architectural advice to reduce the consumption rates.
- 48% of the sample willing to replace traditional mixers with water-saving types (i.e. restoration and replacement (higher cost).
- 60% agreed to buy peripherals to upgrade existing mixers without replacement, in case of availability on market with reasonable cost (lower cost); Fig.11.
- Only 34% of the professional so as architects were aware of water rationalization and sometimes they provided assistance, in that direction, to their clients.



1-Selecting mixers 2- The Architect role

3-Acceptance to purchase complementary units. 4-Acceptance to replace traditional mixers.

Fig. 11. Perception of participant in the questionnaire [15]

7.2. phase 2: calculate of flow rates

A rough measurement process was achieved before and after replacement or adjustment with the architecture design mechanisms. This was achieved to determine the flow rate and the water consumption in the area of study, where the number of family members and age were considered.

The results were tabulated in Table 3. It indicated that the daily water loss rate decreased.

Table 3.
Random sample consumption rates based on the questionnaire [15]

Rate of using taps min/ individual/day			Rates of using taps in houses minutes/ individual/day: Preparing food	Washing dishes	Brushing teeth	ablution	Hand and face washing
			2	3	2	5	3
Average usage rate /time	>3	3	20	9	45	38	57
	3:05	4	33	17	44	49	30
	5:10	8	32	33	9	10	9
	<10	10	15	41	2	3	4
Total minutes/ time / individual Number of times of use * Number of individuals	3		40	27	90	190	171
	4		66	51	88	245	90
	8		64	99	18	50	27
	10		30	123	4	15	12
Minutes							
Total number of daily sessions = Number of people x Number of times x Average usage time	3		120	81	270	570	513
	4		264	204	352	980	360
	8		512	792	144	400	216
	10		300	1230	40	150	120
Consumption in minutes / day	minutes		1196	2307	806	2100	1209
Average daily consumption in kitchen and bathroom min / person:	76 minutes per person (Equivalent to 304 minutes or 5 hours daily consumption of the average family of 4 individuals						
Assuming the flow rate of conventional taps as is not less than 10 liters / min, the daily average loss of fresh water per household:	304 x 10 = 3040 L/ household or housing unit with an average of 4 individuals. Or 760 liters / person This is similar to the value documented in the Central Agency for Public Mobilization and Statistics report (i.e. average per capita daily consumption of fresh water in Cairo is 898 liters / day) [21]						
In case of taps replacement, the flow rate decreases to 6l/day. This denotes that the daily loss decreased.	304x6=1824 L/d denotes 40% saving (i.e. 1216 L/day – 443840 L/year), from each family.						

7.3. Phase III: statistical analysis "SPSS"

Data was analyzed statistically by SPSS 22 software, by implementing the Chi-Square technique to determine variable indicators. It was designated that a relationship exists at $P<0.05$. In addition, a analysis was performed to determine data –variables correlation. The variables were age, type of housing, education, the role of the architect, selection criteria, selection of mixers, mixers replacement, adding supplementary units (architecture mechanism) to rationalize water. The software indicated that certain variables were of obvious influence; Table 4, Fig.12.

Table 4.
The results of Chi square among variables [15]

Sig <0.05				
Variables		mixer selection	mixer replacement	using additional units
House type	Sig.	0.044	0.323	0.201
	Value=R	17.331	6.974	8.541
Education	Sig.	0.605	0.502	0.873
	Value=R	10.130	7.323	3.820
Role of Architect	Sig.	0.010	0.814	0.883
	Value=R	16.906	1.573	1.168
Age category	Sig.	0.019	0.291	0.232
	Value=R	24.221	9.646	10.492

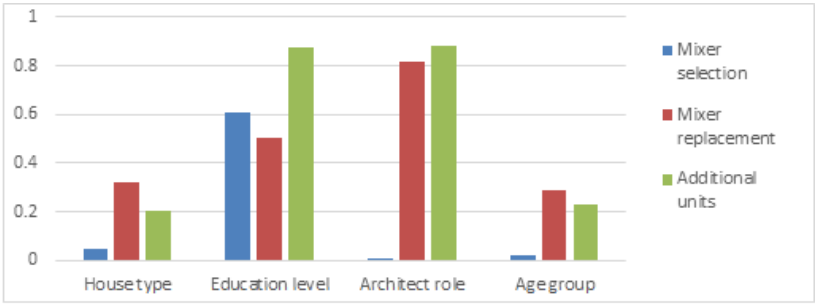


Fig. 12. Chi square test for selected variables [15]

Table 5.
Linear relations between tested variables and their dominancy [15]

Linear Coloration Strength		mixer selection	mixer replacement	using additional units
House type	Sig.	0.056	0.360	0.259
	Strength	Moderate linear	-	-
Education	Sig.	0.796	0.589	0.938
	Strength	-	-	-
Role of Architect	Sig.	0.015	0.799	0.937
	Strength	Moderate linear	-	-
Age category	Sig.	0.004	0.440	0.399
	Strength	Strong linear	-	-

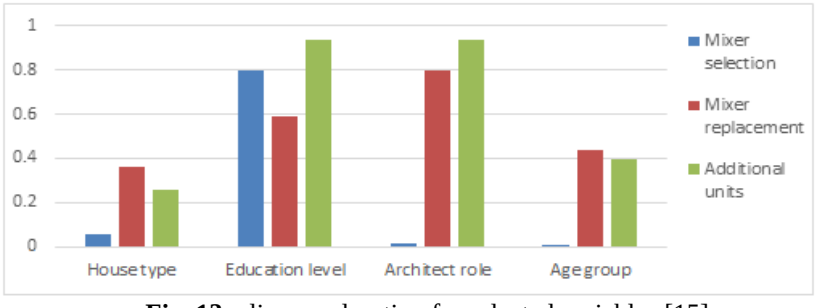


Fig. 13. linear coloration for selected variables [15]

The chi square test indicated that:

- The housing type and selection of mixer was found to the strongest at a Residual>1.96 between over-average house type and choosing mixers that saves water to reduce water bills, While, it was clear that their price was the choice factor for luxury housing for social look without considering saving water or money Table6.

Table 6.
Crosstab for housing type

		Mixer selection			
		Shape	Price	Saving water	Architect choice
Adjusted Residual	20-30	-0.2	-0.3	0.9	0.0
	31-40	0.7	1.1	-1.4	-1.4
	41-50	-.5	0.5	-1.3	0.9
	51-60	-1.1	-1.1	-0.4	0.9
	≥60	0.6	-1.6	**3.8**	-1.0

- The role of architect and selection of mixers was found to the strongest at a Residual>1.96 for the shape of mixer not its functionality or saving features and tis reflect the negative role of architecture practice in the water saving section in this case study Table7.

Table 7.
Crosstab for the architect role

		Mixer selection			
		Shape	Price	Saving water	Architect choice
Adjusted Residual	Youth housing	-0.1	1.1	-0.5	-0.9
	Over-average housing	0.9	-1.0	**2.6**	-1.4
	luxury housing/buildings	0.9	**-2.0**	-0.4	1.6
	luxury housing/villas	-1.6	**2.4**	-1.6	0.0

- The age category and selection of mixer was found to the strongest at a Residual>1.96, where the selection, at ages of (higher than 50) considered the mixer functionality and water saving and this reflect the water consumption awareness Table 8.

Table 8.
Crosstab for Age group

		Mixer selection			
		Shape	Price	Saving water	Architect choice
Adjusted Residual	Yes	**-1.9**	-0.3	-1.2	3.3
	No	**2.0**	0.6	0.7	0.0
	Neutral	-0.5	-0.6	0.6	0.9

- Although there was no clear correlation between other factors, but some remarks were common among them Table 5, Fig.13. These were:

- The effect of over-average house type accepted change to water saving units and to replace them entirely with least waste units, indicated their awareness and desire for rationalization at this category.
- Educational level had a great influence on the replacement of mixers, which indicated their thinking pattern to realize facts and analyze results.
- Older age group agreed quickly to the replacement idea due to their longer experience. They recognized the magnitude of the problem and need for rapid intervention.

- As for the coloration indicator, it was found to be a linear correlation, where a strong correlation was evident between the effects of age on mixer selection, moderate coloration between housing type/ the architect role on mixer selection, while no obvious correlation was found among other variables. This emphasized Chi- Square results; table (5).

Hence, these factors did not affect properly the understanding of the depth of the problem, which calls for raising the level of alert in the development of the field of environmental awareness at all levels and in all disciplines.

8. Conclusions and recommendations

The relation between the architect and mechanical engineer or any other expert in building field is a well-known relationship and does not diminish the role of any of them, each has his own tasks and challenges within the team to ensure the success for the project. But remains the architect is the general coordinator of all specialists and the team's Maestro, he/she is the link between other's work and the end user. Hence, the interior configuration will remain the task of the architect, his/her role is the most important and explained here in the paper to achieve sustainability, beauty and reduce fresh water abuse especially in new urban communities. But as shown in the paper there was no significant role of the architect to save water in new communities neither policies nor architectural practice. This role must be supported and activated in planning, making polices, building regulations, and dealing with end users by sustainable waters saving advices, which is marginalized due to lack of expertise in the planning system or lack of knowledge and awareness of the water problem at user level.

In order to reduce the water consumption, government should invest in water infrastructure, information systems and institutions to go beyond the traditional approach in managing scarcity. City government offices and localities should also encourage policies related to water conservation and efficient use as used in Abu Dhabi (i.e. Pearl rating system and landscaping to reduce water consumption to a minimum) and awards citizens and institution who achieved maximum saving [22].

In brief, it is worthy to mention that water conservation is the most cost-effective way to environmental safety by reducing pressure on lakes, rivers, reservoirs, wastewater treatment facilities. Additionally, this would help in protecting the environment by reducing thermal emission and saving more country resources to the future generation.

For future studies, related ideas could be investigated:

- Adopt using central heaters in new communities which designed with HWRS "Hot Water Recirculation Systems" by mechanical engineer with cooperation with architects to save more water and energy.

- On large scale, evaluate local products in terms of water saving and launch initiatives in collaboration with local bodies and institutions with different engineering specialists to provide trademarks and franchise programs could be more significate in the next years.

REFERENCES

[1] "The World Bank," [Online]. Available: http://www.albankaldawli.org/ar/topic/water/overview. [Accessed 13 2 2018].

[2] "MENA DEVELOPMENT REPORT, Beyond Scarcity Water Security in the Middle East and North Africa," International Bank for Reconstruction and Development, 2018.

[3] القاهرة, 2009 *تغير المناخ وآثاره في مصر* in "م. شلبي, "تغغير المناخ ومشكلة ندرة ومحدودية المياه.

[4] "JMP- World Health Organization," [Online]. Available: https://washdata.org/data. [Accessed 12 2 2018].

[5] "BBC," 2 2018. [Online]. Available: http://www.bbc.com/news/world-africa-43047833.

[6] "BBC," [Online]. Available: http://www.bbc.com/news/world-42982959. [Accessed 2 2018].

[7] S.-A. A. a. P.-R. C., "The importance of water efficiency in buildings in Mediterranean countries. The Portuguese experience," *INTERNATIONAL JOURNAL OF SYSTEMS APPLICATIONS, ENGINEERING & DEVELOPMENT,* vol. 5, no. 1, pp. 17-24, 2011.

[8] K. Retter, "Consumer Reports," 2015. [Online]. Available: http://consumersunion.org/2015/06/stop-wasting-money-start-saving-water/. [Accessed 2 2018].

[9] "Sesam Business Consultants," [Online]. Available: http://www.sesam-uae.com/muscat/presentations/Toufic%20Halabi,%20Grohe.pdf. [Accessed 3 2018].

[10] . Z. Shahzeen and D. Benjamin , "Enviroment. scince and policy for sustainable development".

[11] " Water fact sheet," Heroes of the UAE, Abu Dabi, 2018.

[12] "الجهـــــــاز المركـــــــزي للتعبئـــــــة والاحصـــــــاء," [Online]. Available: http://www.capmas.gov.eg/Pages/Publications.aspx?page_id=5109&YearID=19630. [Accessed 2 2018].

[13] N. Saab, "Consumption Patterns in Arab Countries. AFED Public Opinion Survey," Arab Forum for Environment and Development., 2015.

[14] S. F. Moahmed, "Reuse of graywater in Egypt: Reality and hope," in *Al Azhar's 14th International Conference on: Engineering, Architecture & Technology*, Cairo, 2017.

[15] 2018 ,الباحث.

[16] "Autotaps," [Online]. Available: http://www.autotaps.com/sensor-taps-facts-and-charts.html. [Accessed 3 2018].

[17] "Savewatersavemoney," [Online]. Available: https://www.savewatersavemoney.co.uk/water-efficiency-tips-advice/view/120/tap-aerators---how-do-they-work.html. [Accessed 12 5 2018].

[18] "Amazon," [Online]. Available: https://www.amazon.com/ref=nav_logo. [Accessed 12 5 2018].

[19] "Study on water efficiency standars," European Commission (DG ENV), Paris, 2009.

[20] F. M. ,. D. B. A.M. Fidar, "Performance evaluation of conventional and water saving taps," *Science of the Total Environment,* no. 541, p. 815–824, 2016.

[21] " Built Environment Deprivation Indicator (BEDI)," 10tooba, [Online]. Available: http://10tooba.org/bedi/en/safe-water/. [Accessed 3 2018].

[22] "دائرة التخطيط العمراني والبلديات," [Online]. Available: https://www.upc.gov.ae/estidama/pqp-and-ica/estidama-villa-product-database/water-fixtures-and-fittings.

JES, Assiut University, Faculty of Engineering, Vol. 47, No. 2, March 2019, pp. 250–264

دور المعماري في اختيار الوحدات المستدامة للحد من إساءة استخدام المياه العذبة في المجتمعات الحضرية الجديدة - دراسة حالة "القاهرة الجديدة"

الملخص العربى:

من حيث أهمية دور المهندسين المعماريين في حل المشاكل الضخمة في الممارسة الهندسية في مختلف المجالات ، فهذه الدراسة تهدف الى تنفيذ آليات التصميم المعماري للحد من فقدان المياه العذبة عن طريق الحد من استهلاك المياه في المناطق الحضرية الجديدة ، حيث تم اتخاذ القاهرة الجديدة كدراسة حالة. في المقام الأول، تم استعراض الدراسات السابقة في مجال ترشيد الاستهلاك وفى مجال المياه والموارد المائية. بالإضافة إلى ذلك، تم تحديد الأهداف التي تم التخطيط على أساسها منهجية البحث، حيث تعتمد على منهج تحليلي وصفي ، حيث تم تصميم استبيان إلكتروني وتوزيعه على عينة عشوائية من أجل معرفة مدى إدراكهم لاستهلاك المياه. وعلاوة على ذلك ، تم إجراء تحليل إحصائي لإجابات العينه العشوائية، حيث تم أستنباط جداول ببرنامج SPSS. وأخيراً، وفى النهاية عرضت الدراسة آليات بسيطة قابلة للتنفيذ في المدن الجديدة من أجل ضمان كفاءة استهلاك المياه والحد من سوء استخدام المياه في المجتمعات الحضرية الجديدة. وهذا من شأنه أن يضمن مدادات مياه للجيل الحالي ويحميها للأجيال القادمة. بالإضافة إلى ذلك ، اقترحت الدراسة توصيات للبحث في المستقبل وللتطبيقات الهندسية.