Evaluation of WASH at Sana'a University as per IWRM Perspective

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Abstract:

The Integrated Water Resource Management (IWRM) is considered to be a key in achieving a sustainable improved WASH sector. Water supply and sanitation are among the most essential sectors of development Enhancement of community water supplies and sanitation results in improved social, economic conditions and health. Students are likely to be affected in different ways by inadequate Water, Sanitation and Hygiene (WASH) conditions in schools and universities, so this may contribute to reduce in getting the right learning opportunities. Due to the importance of the WASH sector in improving the community's level and standards, this paper will help to assess the WASH at Sana'a University.

A multi-disciplinary approach to reach the objective targeted in this paper has been used; an intensive literature review has been done, a closed-ended questionnaire was developed with the help of some INGOs standards such as WHO, UNICEF and Sphere to collect the required data from the beneficiaries, a checklist was developed and used to acquire the required data and information from the fields and meet face-to-face with the key informants of each faculty, and all the collected data and information are analyzed with the help of Kobo Toolbox. The findings of the research showed that water shortages and inadequate sanitation were due to weak infrastructure although its own a very strong infrastructure; systems were not repaired or maintained and fell into disuse. In addition, the water supply shortages were also due to insufficient water capacity, physical contaminated existing water sources, lack of communication between university officials, and the obstacles to (WASH) sector which include lack of human resources, lack of financial resources, and unclear roles and responsibilities. The recommendation was based on the findings and related issues with water institution, water sector and resource, sanitation, and hygiene in addition to NGOs to support the university WASH infrastructure.

Keywords: Water, Sanitation and Hygiene (WASH), Sana'a University, Kobo Toolbox and IWRM.

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تقييم المياه والإصحاح البيئي (WASH) في جامعة صنعاء

الملخص:

تعتبر الإدارة المتكاملة للموارد المائية عنصرًا رئيسيًا في تحقيق استدامة قطاع المياه والإصحاح البيئي و يعد توفير المياه والصرف الصحي من بين أهم قطاعات التنمية ؛ يؤدي تحسين إمدادات المياه والصرف الصحي في المجتمع إلى تحسين الظروف الاجتماعية والاقتصادية وتحسين الصحة. من المحتمل أن يتأثر طلاب وطالبات المدارس بطرق مختلفة بسبب عدم كفاية المياه والصرف الصحي والنظافة الصحية في المدارس والجامعات، لذلك قد يساهم ذلك في تقليل فرص التعلم المناسبة. نظرًا لأهمية قطاع المياه والصرف الصحي والنظافة الصحية في تحسين مستوى المجتمع ومعاييره، ستساعد هذه الورقة / البحث في تقييم المياه والصرف الصحي في جامعة صنعاء. تم استخدام نهج متعدد التخصصات للوصول إلى الهدف المستهدف في هذه الورقة / البحث ؛ تم إجراء مراجعة مكثفة للأدبيات، وتم تطوير استبيان مغلق بمساعدة بعض معايير المنظمات غير الحكومية الدولية مثل منظمة الصحة العالمية واليونيسيف وأسفير لجمع البيانات المطلوبة من المستفيدين، وتم وضع قائمة مرجعية واستخدامها للحصول على البيانات المطلوبة و المعلومات من الحقول والمقابلة وجها لوجه مع الأشخاص ذوي المعرفة التامة لكل كلية ، ويتم تحليل جميع البيانات والمعلومات التي تم جمعها بمساعدة Kobo Toolbox. أظهرت نتائج البحث أن نقص الامداد بالمياه وعدم كفاية الصرف الصحي يرجعان إلى ضعف البنية التحتية بالرغم من امتلاكها بنية تحتية قوية جدا؛ لم يتم إصلاح النظم أو صيانتها ووقوعها قيد الاستخدام. اضافة الى أن نقص المياه يرجع أيضًا إلى عدم كفاية السعة المائية و تلوث مصادر المياه الحالية فيزئيا و ضعف التواصل بين مسؤولي الجامعة، العقبات أمام قطاع المياه والصرف الصحي والتي تشمل نقص الموارد البشرية، نقص الموارد المالية، و كذلك عدم الوضوح الادوار والمسؤوليات. استندت التوصية إلى النتائج والقضايا ذات الصلة مع مؤسسة المياه وقطاع المياه والموارد والصرف الصحي والنظافة الصحية بالإضافة إلى المنظمات غير الحكومية لدعم البنية التحتية للمياه والصرف الصحي في الجامعة.

الكلمات المفتاحية : المياه، الإصحاح البيئي، جامعة صنعاء.

1. INTRODUCTION

Water supply and sanitation are among two of the most essential sectors of development [1]. Enhancement of community water supplies and sanitation result in improved social and economic conditions and improved health [1]. The advantages of safe water supply and sanitation are many, including prevention of disease, improved basic health care [17], better nutrition, increased access to institutions such as health centers and schools [16] , better water quality, increased quantity of and access to water, saving of the time and effort required for water collection, promotion of economic activity, strengthening of community organization, improvements in housing, and ultimately, improved quality of life [2].

Sana'a University is considered the pillar of the education sector in the Republic of Yemen as thousands of students (27,741 male and 18,052 female) [3], including both postgraduates and undergraduates study there to acquire different education degrees. However, since the commencement of the ongoing crisis in March 2015, the university has been degraded as there is no proper maintenance for its infrastructure, especially water and sanitation. There is a lack of sufficient amounts of water and adequate sanitation facilities in most of the faculties and sections of the university. Furthermore, no attention is given to the university's surrounding environment. Water availability, adequate sanitation facilities, and proper hygiene practice is a basic need for every individual studying or working in the university, in other words, we can say that there is an absence of the WASH program at the university. This study will be very useful for the university's WASH sector improvement in the future. This study aims to evaluate the WASH at Sana'a University as per the Integrated Water Resource Management (IWRM) perspective with the following sub-objectives:

- To assess the water supply, sanitation and hygiene facilities and infrastructure at university faculties.
- To determine beneficiaries' access to WASH facilities.
- To recommend necessary solutions to improve the WASH sector as per the IWRM for students and staff.
- To suggest and adopt a pilot Sanitation as per FAO – Yemen for Students educational and research purposes.

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In order to achieve the above objectives, the following questions must be answered:

- What are the problems and challenges that face the water supply, sanitation and hygiene facilities?
- What are the requirements to improve the water supply, sanitation and hygiene facilities?
- To what extent are the Yemeni WASH standards meet within the university campus?
- What are the recommended solutions to improve the WASH program?

2. STUDY AREA

Sana'a University was established in 1970 as the first and primary university in the Yemen Arab Republic at that time. When Sana'a University was first established, it had two faculties: the Faculty of Sharia and Law and the Faculty of Education which also included the specialties of Colleges of Arts, Sciences and Education. In 1974, those specialties were developed and three new faculties were formed: Arts, Science, and Education. The Faculty of Sharia and Law celebrated the launch of the Business Department which became an independent faculty a year later. By that time, the university included five faculties, and it continued expanding until it included the rest of the specialties. In 2000, the university included 17 faculties, including all types of academic specialties, ten of which were in Sana'a; the rest were spread around the country [4].

2.1 Location

It is located at the center of Sana'a city within the Al-Maain district where there are residential areas. The city has undergone many heavy airstrikes and bombardments during the ongoing crisis which began in March 2015, and the infrastructures were damaged very rapidly, especially the water and sanitation infrastructure. The university was located at 15°20′53.16″N 44°11′26.83″E [8], see Figure (1).

2.2 Area and Land Use

The estimated area of Sana'a University's three campuses was estimated to be more than 1 Km2 based on Google Earth. Most of the area was allocated

to administrative buildings such as faculties, centers, and administrative blocks, whereas the remaining area was kept vacant without any utilization of the land as shown in (Figure 1).

2.3 Population

Sana'a University is considered to be the pillar of the education sector in the Republic of Yemen as almost 48,000 students(27,741 of which are male and 18,057 of which are female) study there to acquire different education degrees including both undergraduate and postgraduate degrees, in addition, 1750 administrative or academic working staff work at the university as per Sana'a University Statistical report 2018 [3], the number of the student may be more than mentioned as the students in some of the faculties attended on alternative basis not at same time .

2.4 Climate and Rainfall

As the Sana'a University is located within the city, the average summer temperature is about 25° C, and the average winter temperature is around 15° C [4]. In summer, the rainfall is moderate between the month of March and April, and in winter, the rainfall is a little bit higher between the months of August – October. The average rainfall in Sana'a city is estimated to be 200 mm. [4]. The climate of Sana'a city contributes to groundwater contamination as the evaporation rate is low because of lower temperature and the infiltration rate is high and most of the surface runoff is percolated to the groundwater.

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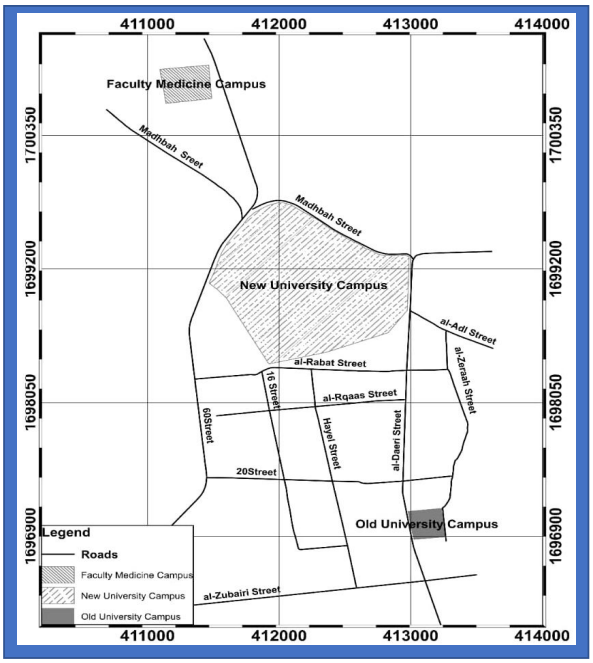

Figure (1): Study Area

3. METHODS

The approaches used in this study are the quantitative method, data collection, and data analysis. According to [5], the quantitative research is about numbers, the counting and measuring of things, in other terms, data is in the form of numbers and statistics. A quantitative approach for data collection was developed. The research was performed using the quantitative method and employed the closed-ended questionnaires [5]. The purpose of using closed-ended questionnaires in this study was to:

- Quantify data and generalize results from a sample of the population of interest.
- Measure the incidence of various views and opinions in a chosen sample.
- Collect data from a large population.
- Collect numerical data for data representation and analysis.

3.1 The Research Design (Framework)

A research design is the description of methods and procedures for acquiring the information needed. A multi-disciplinary approach was used to reach the objective targeted in this study. Figure (2) shows the component of the research framework.

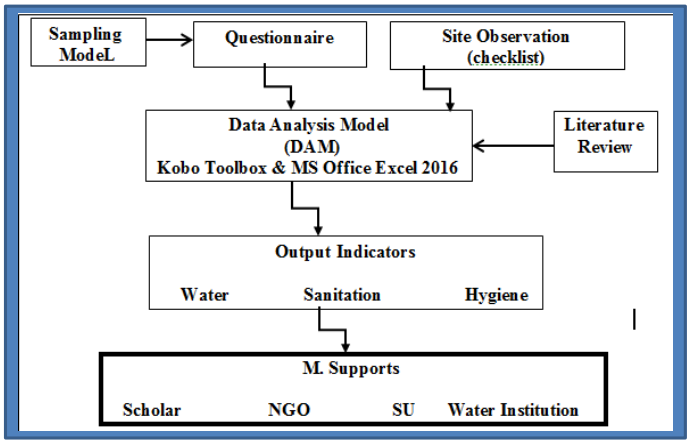

Figure (2): Component of the Research Framework

3.2 Component of Research framework

3.2.1 Literature Review

A literature review was utilized to collect secondary data. The information was obtained from journals, official water reports, approved dissertations, and the internet. The data and information were collected from international, continental and local documents. International, continental and local documents were referred to in order to understand water, sanitation and hygiene problems in schools as well as healthcare and public institutions throughout the world. In addition, the monthly, quarterly, and annual reports of the NGOs and INGOs working in water, sanitation and hygiene sector in Yemen such as UNICEF, WHO, and Yemen WASH cluster have been reviewed [10,11, 13, 14, 15, 17].

3.2.2 Questionnaire

The Paper employed the use of questionnaires utilizing Kobo toolbox. Questionnaires were used to collect quantitative data (closed-ended questions). The questionnaires were distributed personally in each faculty in the university three campuses: old, new, and faculty of medicine, some part of it was shared by social media group of the university student.

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Closed-ended questions:

the questionnaire included mostly closed-ended questions because these types of questions are easy to analyze since they are made of numbers rather than opinions. The questionnaires were multiple choice questions where the respondents were asked to choose one answer from among a set by checking the box which was next to the answer and some semi ended questions were added to see the respondents views [6,7].

An introductory part was added on the first page of the questionnaire which was formatted in such a way that the first part asked for general information about the student/staff: his/her gender, faculty, and level of study. The second section inquired about the necessary data concerning the faculty water resources and drinking water point status in terms of quality and the quantity, consumption, cost and the problems. The third section was about the sanitation, hand-washing basins and latrines infrastructure of the faculty in terms of ease of access, current status, privacy, water availability, availability of handwashing basin nearby and the sanitation problems. The final part of the questionnaire was about the hygiene activities done in the faculty in terms of cleanliness, waste accumulation, food preparation within the faculty cafeteria, past illness history from water-borne diseases and finally s/he asked about his/her opinion on how to improve the WASH sector in the faculty.

The questionnaire constructed was guided by the research objectives and questions. Once the questionnaire was finalized, it was tested before it was used on a large scale of students to see if it was obtaining the required results. This was done by asking the supervisor and some statistics professionals to read it through and see if there were any ambiguities that might have gone unnoticed. They commented on what needed to be correct, including the length, structure, and wording of the questionnaire. They also commented on its suitability and comprehensibility by the students and staff, and then it was simplified in order to be understood by students of all levels.

3.2.3 Sampling

Sample size is a count of individual samples or questionnaires in any statistical setting, such as a scientific experiment or a public opinion survey. Albeit a relatively straightforward concept, choice of sample size is a critical determination for a thesis. Too small a sample yields unreliable results, while an overly large sample demands a good deal of time and resources [9].

Two equations have been used in this paper to determine the sample. Steve Thamson provides a simplified formula to calculate sample sizes. This formula was used to calculate the sample size [7]:

$$\mathbf{n} = \frac{\mathbf{NPQ}}{\frac{(\mathbf{N}-\mathbf{1})\mathbf{e}^2}{\mathbf{z}^2}+\mathbf{PQ}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Population size (P), Q, and z disappeared because they were replaced by actual values. Population size, P is assumed to be 0.5, which automatically results to a Q value of 0.5 since Q = 1-P = 1- 0.5 = 0.5. The number 0.5 is the P value that yields the highest possible of precision

Where

n is sample size

N is population size (47548)

P is Neutral Levels 0.5

e is percentage of error 5%

z is the standards score cross ponding to significance Level 95% is 1.96

The formula to calculate the sample size was given by Robert Mason (Balachin 2017) which is as below [8]:

$$\boldsymbol{n} = \frac{\boldsymbol{N}}{((\boldsymbol{N}-\mathbf{1})\boldsymbol{z}^2/\boldsymbol{PQ})+\mathbf{1}} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

z the standards score cross ponding to significance Level 95% is 0.02551

After applying the values in the above equation, it was concluded that the total number of questionnaires required for this thesis was 381which were to be distributed equally all over the university (three campuses and faculties) for both the students and staff. In total, 400 questionnaires were distributed as shown in Table (1) out of which 17 questionnaire was neglected due wrong representation of information.

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Table (1): Distribution of the Questionnaire

.No.	Faculty	Purposed Questionnaire	Male Student	Female Student	Staff
1	Agriculture	30	19	9	2
2	Computer Science	38	25	11	2
3	Commerce	34	22	10	2
4	Dentistry	38	25	11	2
5	Education	25	16	7	2
6	Engineering	38	25	11	2
7	Language	36	24	10	2
8	Literature	30	19	9	2
9	Media	38	25	11	2
10	Medicine	38	25	11	2
11	Science	30	19	9	2
12	Sharia	22	15	6	1
13	WEC	3	1	1	1
	Total	400	260	116	24

Random sampling was used to select the students and staff ; this is because random sampling gives each individual an equal chance to be selected.

3.2.4 Site Observation

Another method used was site observation. Time was spent in the university and each individual faculty was visited, observing water sources, sanitation facilities, and hygiene methods that were currently used by the students and staff. The observation was done by taking pictures of water resources and toilets that are currently used with a smartphone camera. Extensive notes were written during picture-taking in order to assist the researcher in remembering important information when analyzing the data.

A checklist had been prepared in order to simplify the field observation data and information collection for the researcher while observing the adequacy and utilization of the water resource, drinking water points, and sanitation facilities in each individual faculty that he visited. This checklist was prepared with the help of the standards checklist prepared by the INGOs such as WHO and UNICEF who are working in WASH sectors in the schools, educational institutions, and health care centers[14, 15, 19]. See Table (2).

Table (2): WASH Evaluation Field Checklist

Date:	**Faculty/Centre**: There were visit for 26 blocks of the university faculties that located within the three campuses of the University		
No	Description There were visit for 26 blocks of the university faculties	Yes	No
1.	Is the source of the Water protected from contamination?	19	7 There were some water storage were not cover properly
2.	Is there regular monitoring of water quality?	0	26 There were no any monitoring over the water resources of the university either for drinking nor water supply
3.	Are there any drinking water points? if yes, how many?	12 the drinking water points were available only in 12 blocks of university with an average 2 drinking point in each block	14
	Does the drinking water quality meet the Yemeni Drinking water 1999 and WHO2018 Standards	All of them were meet the drinking standards as it was confirmed by NWRA that monitor the quality of the drinking water supplier	
	Is water acceptable? Smell, taste, appearance	All of them were acceptable	
4.	Does the water meet the faculty requirements (needs)	2 only two of the visited blocks of faculties meet their needs from water	24

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Table (2): Continued

Date:	**Faculty/Centre**: There were visit for 26 blocks of the university faculties that located within the three campuses of the University		
5.	Are there enough water points in the right places for drinking and/or other uses/cleaning/ washing	10 There were available near the lobbies and prayer location of the faculties	16
6.	Are there sufficient sanitation facilities for men/ women within the faculty? If yes, how many men/ women?	25 With average 12-13 toilets for boy and girls students As seen and confirmed by the maintenance dept only 1/3 of toilets are opened for use	1 Only one block of the faculties was not provided with enough toilets
7.	Are the sanitation facilities located in the right places?	17	9 Some of them were located just near by the lecture halls
8.	Do the sanitation facilities provide privacy and security for men/ women?	7	19 Most of them were with broken doors locks and lack of the required repairing and girls student were complaining regarding this issue
9.	Are the sanitation facilities hygienic and clean	3	23 Most of the were not clean as required during the site observation
10.	Are there handwashing facilities close by?	23	3 Three blocks of the faculties were notices that the hand washing basin were not available in fact broken and completely destroyed
11.	Are the handwashing facilities provided with soap?	0	26 All the visited blocks were not provided with any type of the soap

Table (2): Continued

Date:	**Faculty/Centre**: There were visit for 26 blocks of the university faculties that located within the three campuses of the University		
12.	Is the water is available at the washing basin?	7 Only within seven blocks of faculties were water was available in their handwashing basin	19
13.	Is there a schedule for cleaning the sanitation facilities?	2 Only two faculties were having regular cleaning schedule, although was not followed	24
14.	Are the floors, lobbies, classrooms, and surroundings clean?	12	14 Some of the blocks the cleanliness were ignorable
15.	Is there adequate dustbins with covers and other tools for managing solid waste	7	19 Most of the blocks were not provided with sufficient number of dustbins and adequate tools
16.	Is there any solid waste accumulation at the faculty	11	14 There were poor disposal of the waste, dustbins were over filled and waste was disposed outside the waste bins
17.	Is the food prepared in a hygienic way inside the cafeteria?	18 The facilities that own their cafeteria	5
	Is the food covered and protected inside the cafeteria?	17	6
18.	Is there any maintenance and cleaning plan?	1 Only one faculty was having maintenance plan in case of emergency	25

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Table (2): Continued

Date:	**Faculty/Centre**: There were visit for 26 blocks of the university faculties that located within the three campuses of the University			
19.	Is there any hygiene promotion activity within the faculty?	1 Only one faculty was having some of awareness posters	25	
20.	Is there any health facility within the campus?	All the faculties were having a health facility except one. And all of them were closed during the site observation due unavailability of pharmaceutical and required tools		
21.	Are there any WASH facilities for the disabilities students?	No one faculty was having any WASH facilities for disable students		
22.	Who is responsible for providing the service of WASH Maintenance/ Cleanness/ Water?	Maintenances Department of Maintenance of the faculty and university	Cleanness Faculty own manpower in addition to one private company for cleaning services	Water Private water tankers, university water pipeline and water tankers

During the field visit to each faculty, the researcher set and meet with the key informants of each faculty, the dean, general secretary, and service and maintenance in charge of the faculty, because they are considered to be the key members within the faculty who are most knowledgeable about the faculty's situation and problems. The purpose of the meeting was to get clarity on some information that was necessary to draw conclusions. A number of questions were prepared for the meeting beforehand and the answers were recorded immediately through writing notes. The meeting was arranged one day before through a personal visit with an official letter from the Water and Environment Center (WEC). Most of the faculties welcomed the researcher and were eager to discuss the real problems that they faced and find solutions. In addition, the water samples have been taken from the wells of the University for testing by the Aqua Filtration Company for drinking water quality tests as per WHO 2018 standards [10].

3.2.5 Data Analysis

Data analysis was carried out using Kobo Toolbox [12]. A database was created. Every answer item on the questionnaire was carefully entered as a numbered code. Each questionnaire was carefully entered in the Kobo Toolbox database going through each questionnaire after entering data was done for accuracy as well as referring back to the aims of the study.

Kobo Toolbox, founded by the Harvard Humanitarian Initiative, is an open foundation suite of tools for data collection and analysis in humanitarian emergencies and other inspiring environments [12]. After that, the analysis was checked manually. The database downloaded from Kobo Toolbox was organized into pivot tables and charts in a Microsoft Excel 2016 worksheet that was used to draw graphs. The graphs used were bar and pie charts for data presentation. The graphs used contained frequencies and percentages which were important in illustrating the findings.

4. Results and Discussions

The results and the findings of the evaluation of WASH at Sana'a University are presented in the form of graphical shapes and tabular forms.

4.1 Respondents distribution for the questionnaire

Figure (3) shows that the percentage of the respondents in terms of gender. It is shown that 65% of the respondents were male students and working staff in the university, whereas 35% of the respondents were female students. From Figure (4) we observe that the respondents were distributed over all the university faculties equally. There is some variance in coverage of some faculties due to the absence of the students when conducting the questionnaire. Figure (5) shows the coverage of the university campus and the respondents. The new campus has the majority of the responses with 65% because of the density of students and faculty staff there, whereas the old campus and the faculty of medicine campus are matching in coverage with 16% and 19%, respectively. Figure (6) showed clearly that the majority of the responses came from the students (352 out of 383) because they are the main beneficiaries of the WASH services provided by the university. The academic and administrative working staff contributed 17 and 14 responses, respectively.

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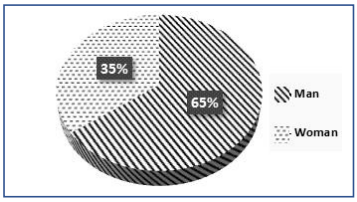


Figure (3): Gender of the Respondents

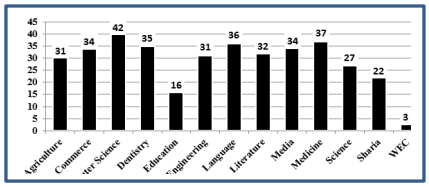


Figure (4): Distribution of the Respondents over the University

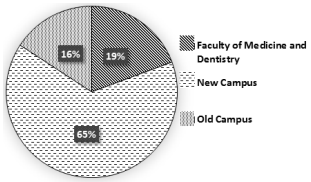


Figure (5): The Coverage of the University Campus

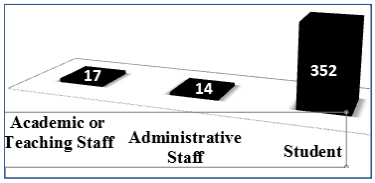


Figure (6): Respondents

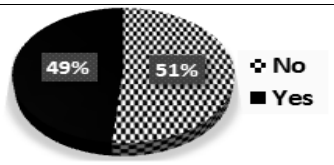
4.2. Respondents Distribution for The Questionnaire related to WASH

4.2.1 Water

In this section, all the finds related to the water are discussed in terms of water quality, quantity, and ease of access. The responses to the questions which related to water are cleared in Table (3). Regarding to question (1); Figure (7), it is noticed that: on average only 3 drinking points are available in each faulty that is used by all the students and working staff within the faculty. As per sphere standards, the quantity of drinking water that must be available per person per day is 3 liters which means the total quantity of drinking water required to meet the drinking purpose must be 137000 liters per day. Hence, the drinking water quantity was not met within Sana'a University. The water resources of the university determined with the help of the checklist (related to question2), See Figure (8). Here it is noticed that, the water supply network of the university have a good infrastructure but unfortunate its unusable due to some operation problems and unavailability of the fuel. The water supply network of the university was designed to meet the university water need as per its requirement. Referring to the response of question3 (Figure 9), It is clearly notified that the almost all the facilities did not have enough drinking water points available, also while the fields visits to the facilities it was notified that the drinking water points were not available at all and if they were available only limited in their numbers, the only computer science faculty that the drinking water points was present even its not meet the faculty need from the drinking water. The response of question 4 is cleared in Figure (10) and almost half of the university people depend on these water

facilities for drinking. Figure (11) shows the satisfaction of the drinking water consumers with the quality of the drinking water available at the university faculties and on the other hand, the researcher asked the supplier of the drinking water for university faculties and he obtain information confirming that the drinking water quality met with Yemeni drinking water (1999) [11] and WHO standards[10], as there was regular monitoring for the water quality supplied by the National Water Resource Authority (NWRA).Regarding to Figure(12),we could conclude that the drinking water is not available at the university faculties at all. Figure (13) shows the cost of drinking water, we know that the bottle of one liter cost 100 Yemeni Riyal, the total amount spent on drinking water will be 7.5 Million Riyal per day. This amount can be utilized to establish purification of the university water resource and to build a water treatment plant within the university campus, minimizing the expenditure on drinking purposes and meeting the drinking water quantity requirement of the university. The drinking water was not only costly, but it was also very far away Figure (14), as mentioned by some of the students. that the drinking water points are far from the academic section with an average distance of 300 meters. Some of the students mentioned that they have to go outside of their faculties to drink the water, and sometimes they miss some of their class or enter the classroom late. And according to the site observation there weren't any drinking water points available at the right places within the faculties; if available they were either not covered or protected from contamination or an insufficient quantity was available, see also the response in Figure (15).

Table (3): Response of Questionnaire related to Water

No.	Description	Response	Figures
1	Are there any drinking water points or facilities available within the faculty?	49 % Yes 51 % No	 Figure (7)

https://doi.org/10.20428/JST.25.2.3

Table (3): Continued

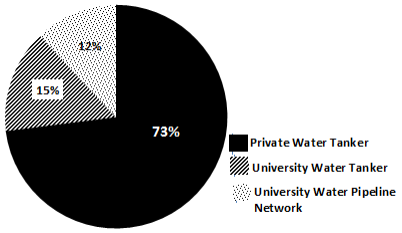
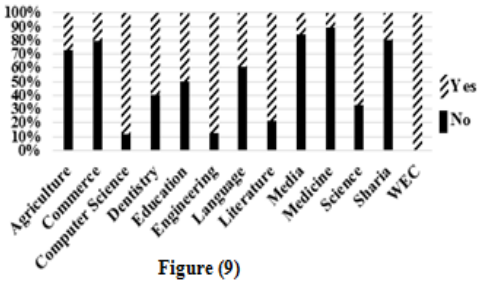
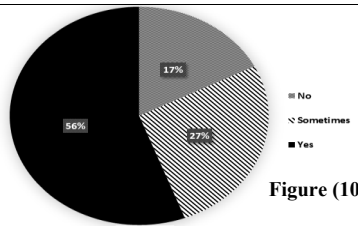
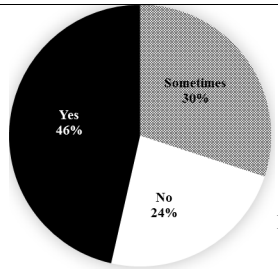
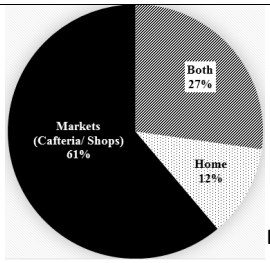
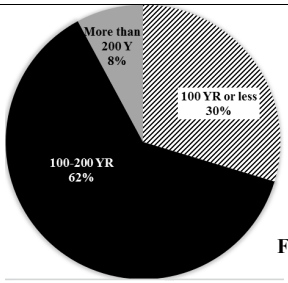
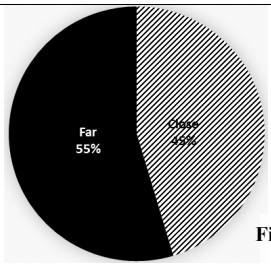
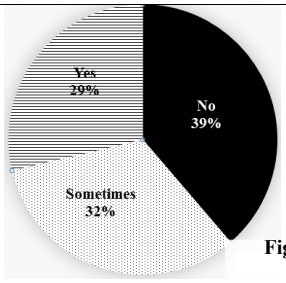
No.	Description	Response	Figures
2	What Is the Water Source at University Faculties?	73 % Private Tanker 15% University Water Tanker 12% University Water pipeline	 **Figure (8)**
3	The drinking water availability at drinking points in the faculties	41% Always 56% Sometimes 3% Never	 **Figure (9)**
4	Are You Using Drinking Water from the Facility?	56% yes 27% Sometimes 17% No	 **Figure (10)**
5	Are You Satisfied with the Drinking Water Quality?	46% Yes 24% Sometimes 30% No	 **Figure (11)**

Table (3): Continued

No.	Description	Response	Figures
6	*If there are no Drinking Water Facilities within the Faculty, from where do You Obtain Drinking Water?*	61% Market 27 % Both 12% Home	 **Figure** (12)
7	*How Much Does Drinking Water Cost You During You 're Presence at University?*	62 % 100-200 YR 30% 100 YR or less 8 % More than 200 YR	 **Figure** (13)
8	How Far Is The Drinking Water Facilities From Classrooms, Lobbies, and Workplaces?	55% Far 45 % Close	 **Figure (14)**
9	Is The Drinking Water Source Protected/Covered From Contamination?	29 % Yes 32% Sometimes 39 % No	 **Figure (15)**

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4.2.2 Sanitation facilities (toilets/latrines)

The responses to the questions which related to sanitation facilities are cleared in Table (4). Although the sanitation facilities are available everywhere within the university faculties, only a few of them are suitable for use. Most of them are either closed due to lack of maintenance and repairing or have been transformed into a warehouse for storing purposes; only one-third of latrine or toilets are available for boys/girls. 93% of responses mentioned that the sanitation facilities (toilets/latrines) are present at their faculties and 7% mentioned they were not present due to the fact that most facilities are present but closed, see Figure (16a). On average, around 12 latrines were opened for students to use. However, as stated by most of the universal standards, a minimum of one latrine must be available for every 30 female students and one latrine for every 60 male students [15]; therefore, at least 462 latrines have to be available for male students and 602 latrines for the female students as shown in Figure (16-b). As for the working staff, there must be 88 latrines within the university campuses to meet the minimum requirement for sanitation services.

The other parameter that all the WASH standards refer to in regards to the sanitation and latrines is the cleanliness. During the site observation, the cleanliness status of the latrines, hand washing basins, and sanitation facilities within the university faculties did not meet the required cleanliness, see Figure (17). Most of them were unclean (62%), broken (37%) and unsuitable for use, whereas some of them were closed due to lack of maintenance. The general secretary of the faculty was asked the reasons behind the terrible situation of the sanitation facilities. He stated that the students did not know how to use the sanitation facilities as required; some of the water taps were stolen and the drainage network was blocked by adding garbage on the sinks, especially by the female students. Only 34% of respondents said they were clean and suitable to use, so the university did not meet the minimum requirement for the sanitation facilities in terms of cleanliness. The universal standards for sanitation facilities state that there must be privacy and security while going to or using these facilities, particularly for women and children. As shown in Figure (18), most of the responses (44%) mentioned that the sanitation facilities ensure this parameter, while 31% mentioned that they did not ensure the privacy and security. Most of the negative responses came from female students. Some of them mentioned that "we cannot use the toilets and sanitation faculty in the afternoon as there is no security or

privacy". Some of the latrines do not have even lighting and become dark. We have been absent a few days from the university because we cannot use the latrines of our faculty. The most important measure for sanitation facilities is that they must be within 30 meters of classroom and lobbies as per WHO WASH standards [21]. Figure (19) shows how far the sanitation facilities are from classrooms and lobbies. most of the responses (71%) mentioned that they were close, whereas 29% of responses mentioned that they are far with an average distance of 230 meters. Other responses that the hand washing basins were present nearby the latrines with 62% responses while 38% mentioned that they were not present; see Figure (20), unfortunately, there wasn't any soap present, even in the staff latrines. The water availability in the water taps of the washing basins is the main element that also was not available due to broken pipe networks, and some of the washing basins were completely broken.

Table (4): Response of Questionnaire related to Sanitation

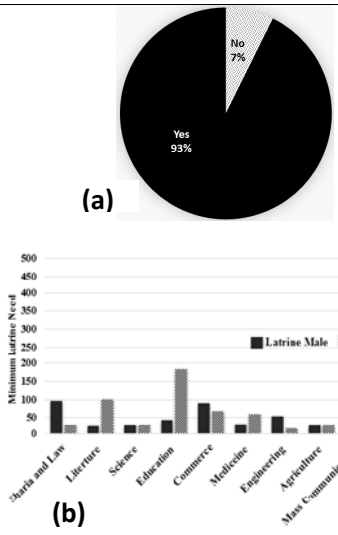
No.	Description	Response	Figures
1	Are There Sanitation Facilities (latrines/toilets) Within Your Faculty? And total latrines needed	93 % Yes 7 % No	

Figure (16)

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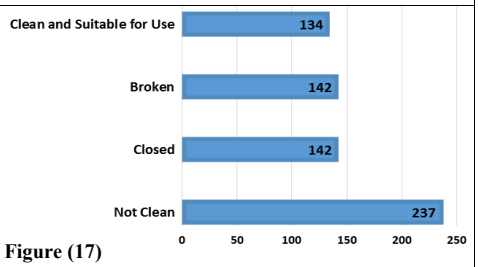
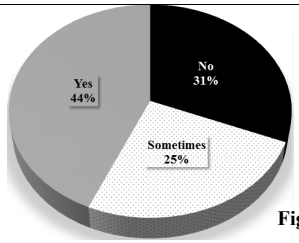
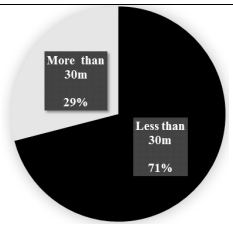
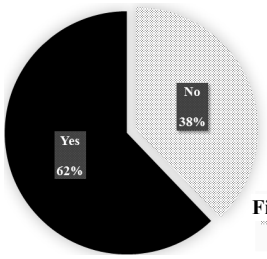
Table (4): Continued

No.	Description	Response	Figures
2	What Is The Status of The Sanitation Facilities (latrines/toilets) At Your Faculty	62 % (237) Un-cleaned 34 (134) Clean 37 % Broken 37 % Closed	 **Figure (17)**
3	Are The Sanitation Facilities (latrines/toilets) Provide Privacy And Security?	44% Yes 25 % Sometimes 31 % No	 **Figure (18)**
4	How Far Is Sanitation Facilities (latrines/toilets) From Classrooms, Lobbies, and Workplaces?	71% Close 29% Far	 **Figure (19)**
5	Are There Any Handwashing Facilities Close By?	62 % Yes 38 % No	 **Figure (20)**

4.3 Hygiene

The third parameter of WASH is hygiene. During the site observation of the university faculties, a lack of hygiene activities and promotion within the faculties and the surrounding area was observed. the cleanliness status of the faculties lecture rooms, lobbies, halls, and surrounding there were Consensus within the response that the cleanliness status was conducted

sometimes neither as per regular schedule nor daily basis and that was due to lack of the manpower who's were responsible for the cleanliness of the facilities, only two faculties were noticed to have proper cleanliness schedule during the field visit and they were Engineering and Dentistry; See Figure (21) in Table (5). Regarding the question "Dustbins Distribution at faculties" for the solid waste management; most of the responses consensus that the dustbins were available all the time at the right places, while conducting the checklist it noticed that the dustbins were available but not as per the need and was distributed randomly all over the facilities and some of them was full of the waste, all the dustbins were without covers; see Figure (22). In Figure (23) most responses mentioned that the cleanliness activity within the faculties was good with 43% and 42% saying the cleanliness was conducted regularly and sometimes, respectively. In regards to the presence of the necessary tools to collect the garbage and trash such as dustbins in suitable locations, 40% of responses mention that they were regularly and another 40% responded that they were sometimes During the site visit, the cleanliness level was not as per required as some of the classrooms and lecture halls were full of trash and dust. While sitting with some of the cleaning staff, they discussed their problems such as insufficient payment and unavailability of necessary tools and materials supplied by the subcontractor. Additionally, they mentioned that the cleaning staff must be increased. Therefore the cleanliness was not conducted regularly as mentioned by the respondents with 57% declaring the cleanliness was conducted sometimes. Regarding the Figures (24 &25), most of the responses were completely negative in terms of preparation and protection of the food that was available at the university. Figure (26) demonstrates waterborne disease within the university among the students and working staff during their study and working period. It's shown that 50 students suffered from kidney-related diseases, 29 students suffered from cholera which could be high-risk indicators, 26 students complained about dental issues, 16 students underwent osteoporosis, 16 students suffered from malaria, and 6 students suffered from dengue fever. These figures gave an alert indication of high-risk diseases that speared within the university population and must be taken into consideration.

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Table (5): Response of Questionnaire related to Hygiene

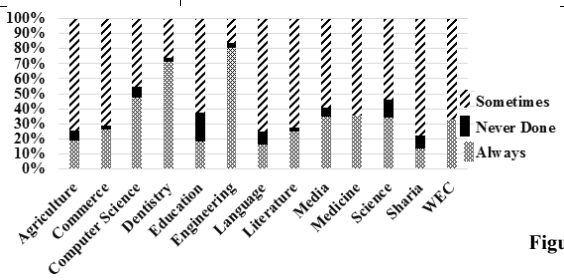
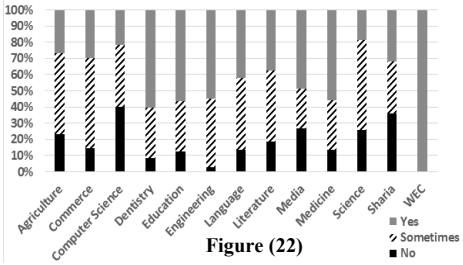
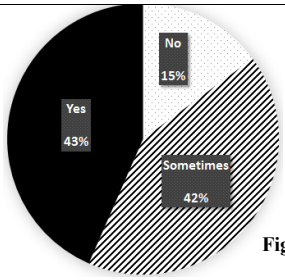
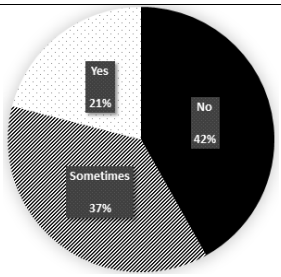
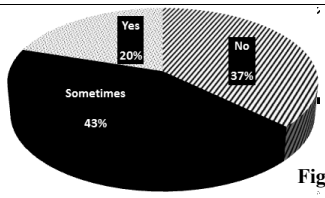
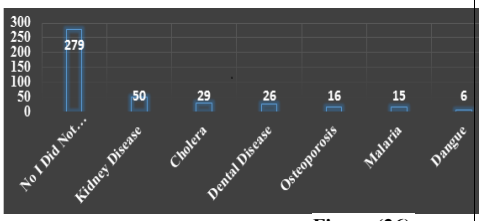
No.	Description	Response	Figures
1	What is your opinion about cleanness status in the faculty?		 **Figure (21)**
2	Are There Adequate Dustbins In The Classrooms, Lobbies, and Faculty Surroundings?	40% Yes 40% Sometimes 20% No	 **Figure (22)**
3	Are The Classrooms, Lobbies, and Faculty Surroundings Cleaned and Hygienic?	43% Yes 42% Sometimes 15% No	 **Figure (23)**
4	Is The Food Prepared In A Hygienic Way Inside The Faculty Cafeteria (cafeteria labors, gloves, kitchen cleanness, cleanness of used tools)?	21% Yes 37% Sometimes 42 % No	 **Figure (24)**

Table (5): Continued

No.	Description	Response	Figures
5	Is The Food Covered And Protected Well Inside The Faculty Cafeteria	20% Yes 43% Sometimes 43% No	 Figure (25)
6	Did You Suffer From Any Waterborne Diseases During Your Studies And Working Period Within The University?	279 Did not Suffer 50 Kidney Disease 29 Cholera 26 Dental Disease 16 Osteoposis 15 Malaria 6 Dangue	 Figure (26)

5. Conclusion and Recommendation

It is concluded that the university water requirement did not meet the minimum requirement as per Sphere standard which is about 687 cubic meters per day [15]. The water storage infrastructure of the university faculties need to reconsider in terms of replacement, maintenance, and cleanliness, there was no department or section responsible to monitor the water quality neither for the university nor the faculty. The sanitation infrastructure of the university was retrograded with time as there was no frequent repairing and maintenance. Only one-third of the sanitation facilities of the university were open and allowed to be used, whereas the other two-thirds were closed permanently or converted to warehouses (from field observation and meeting with key information of each faculty). From the analysis, most of the students do not use the sanitation facilities of the university regularly as there was no regular water availability, cleanliness, or privacy, broken and sometimes they would have to go to another faculty. For instance, the site observations revealed poor disposal of solid waste as dustbins were ignored and solid materials/waste were disposed just outside the bins even when the bins were not necessarily full, insufficient numbers of waste bins and poor solid waste management. There was poor preparation of the foods inside the faculties' cafeteria as there is no monitoring of cafeteria staff and kitchens which may lead to poor quality of food that the students consumed.

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It is recommended that there must be a department within the university that takes on the responsibility of the water resource of the university in terms of the quality and quantity by monitoring the water quality and repairing maintaining the sanitation infrastructure.

Also it is recommended to establish a water purification plant within the university campus and adopting rainwater harvesting techniques with the existing infrastructure that requires maintenance.

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