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INVESTIGATING THE PROPER USE OF LITANI RIVER BASIN BASED ON WATER QUALITY

Abstract

Litani River Basin (LRB) with a 170km length and annual river flow of 750 MCM is considered the most important water resource in Lebanon. Unfortunately, the river is facing water contamination as a result of human practices. Water Quality assessments was performed in the Litani River Basin using a combination of Principal Component Analysis method (PCA) and Water Quality Index method (WQI). Results revealed the improvement of the water quality significantly after passing lake Qaraoun. Moreover, according to WQI, Lower LRB water is ranked "Good" for irrigation and "BAD' for drinking purposes. Microbial contamination is found to be the key factor in determining the usage of water for agricultural and drinking purposes due to the propagation of *Escherichia coli* in water samples. Stakeholders should take immediate actions to resolve microbiological contamination in Litani Lower River in order to perverse its water for irrigation activities and supplying drinking water.

Keywords

Litani River Water Quality, Principal Component Analysis, Water Quality Index

1. INTRODUCTION

Lebanon has a land area of 10,452 km^2 and a population of approximately 4.4 million, excluding migrant workers. Most of the country is mountainous and it is limited to around 250,000 ha of cultivable land. 90,000 ha of this area is designed for irrigation. Rivers and springs provide about half of the irrigation water amount and the other half of the groundwater. There are 17 main rivers in the country, three of which are international; (with Litani river being the largest one) about 2,000 springs; and almost 50,650 wells. Water, however, is unevenly distributed between regions and between seasons and, due to steep slopes, is difficult to harness in some areas. As a result, Lebanon annually loses an estimated 1.4 BCM to the sea, a cause of great concern to the nation. The total water demand is increasing approximately 100 MCM every 5 years which increases the pressure on the available water resources to satisfy the needs of different water sectors. Therefore, if no steps will be taken to increase the quantity of water supply, all forecasts point to a significant water deficit over the next decades.

The Litani River, the largest water resource for Lebanon, has a catchment area of 2110 km^2 (about 20% of Lebanon) and a length of 170 km, with an average annual discharge of 385 MCM per year (Shaban et.al 2018). Water Pollution of the Litani River is one of the major challenges facing the river. A few years ago, microbiological and chemical analysis of river water (surface and underground) showed that pollution had exceeded twice the normal level. The reason for this serious situation is the lack of control and the increase in violations, especially in the transportation of wastewater, including the treatment of liquid and solid waste into rivers. Many researchers have documented the water quality degradation along the Litani River. Haddad et al., 2001 returned the reason of water quality degradation to the unregulated growth of unlawful private drilling for irrigation reasons, along with the excessive use of fertilizers in intensive agriculture. Nada Nehme, 2014 revealed that domestic, agricultural, industrial, and irrigation operations all contribute to pollution and consequently have an impact on surface water. In addition, the uncontrolled use of chemical fertilizers in agriculture will have a negative impact on water quality, especially groundwater quality (Darwich et al. 2011; Baydoun et al. 2015). Dmour, J et.al. 2009, carried out a sampling campaign in the Litani River in October 2005 to verify the contamination levels in different places of the Litani River. The results showed an increase in fecal coliforms at sampling points at wastewater discharge points located downstream from tourist centers. Nitrate-nitrogen, Orthophosphate and total dissolved solids were found significantly high in the Litani River at the end of the coast (6.5, 0.39 and 432 mg /L, respectively) due to high agricultural activity and banana irrigated lands surrounding. The BOD value was relatively lower than the detectable limit, which may be due to the dilution effect, because no sampling was carried out during the decline of the river. Haydar et. al 2014, investigated the distribution of heavy metals in the Lower River. The results showed that Fe, Cd, Ni, and Cr concentrations were higher in the dry season than in the wet season owing to dilution by precipitation, which affects concentration and heavy metal mobility.

Water-quality indicators offer baseline data and aid in identifying temporal variations in water quality across a range of climatic circumstances. They help scientists investigate problems like nonpoint-source pollution and nutrient enrichment, and they can pinpoint the sources of contamination. They also explain how certain water-quality measures describe river health and the factors that influence it. These metrics provide suggestive data that may be used to identify probable causes of water contamination, (APHA 1995). The ultimate goal of imposing water-quality indicators (which may need full treatment before use) is to safeguard consumers, whether people or animals and the aquatic ecosystem as a whole.(Wisconsin 2003). Among those indicators are Water Quality Index and Principal Component Analysis (PCA).

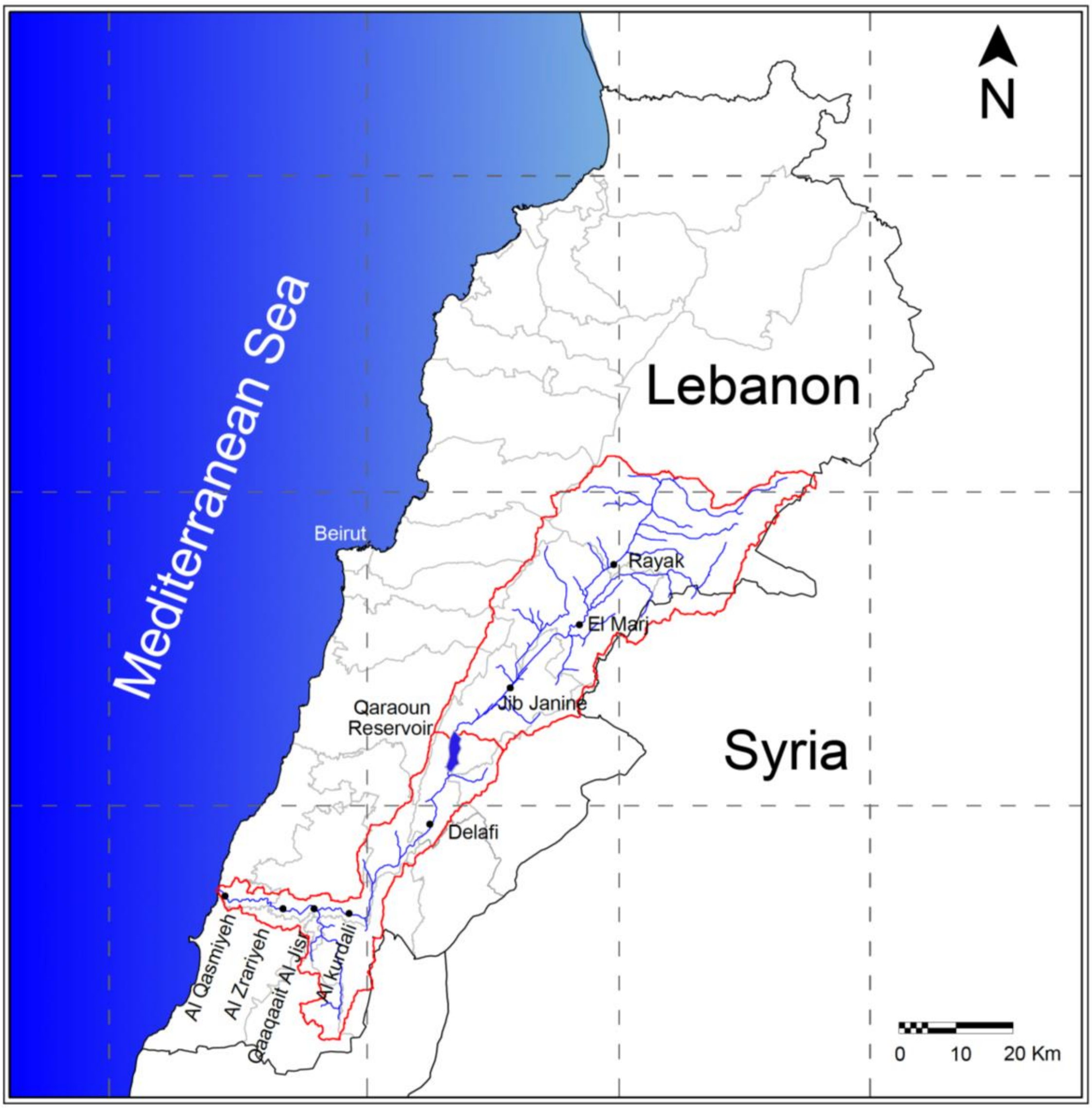


Fig.1: study area layout and water quality monitoring sites along Litani River Basin (2013-2014 and 2019 campaigns)

Water Quality Index (WQI), which considers the impact of physical and chemical characteristics on the quality of a water sample, can be an efficient tool for converting complex parameters into a more understandable form, (S.N et al., 2020) Different studies used the WQI methods in order to evaluate the river water qualities. For example, Jyothi S.N. et al., 2021, performed a study on assessing the water quality index and the impact of pollution on Kerala rivers. The selected study area contained 44 rivers. Two WQI methods were used to calculate the WQI of Kerala rivers, namely; the Canadian Council of Ministers of the Environment (CCME) method (S.N et al,. 2020) and the Indian method (S.N et al,. 2020). For the Canadian WQI method, five parameters including pH, dissolved oxygen, BOD, total coliforms, and fecal coliforms were measured over six years (2012-2017) to calculate the WQI. On the other hand, eleven parameters were used in the Indian model and these include pH, total hardness, conductivity, calcium, total dissolved solids, total alkalinity, magnesium, dissolved oxygen, nitrate and biochemical oxygen demand. The study showed that most of the selected rivers for WQI calculation had good water quality.

Moreover, Data diagnosing by Principal Component Analysis (PCA) allows to reduce the number of variables and to detect the relations between variables. Baydoun et al. 2016, assessed water quality in the Upper and Lower Basins of Litani River using Principal Component Analysis (PCA) method. The data of five stations (two stations located in the upper Litani basin while three stations located in the lower basin) for fifteen water quality indicators were studied during the period of 2013-2014. The results revealed that the upper Litani Basin characterized has higher level of eutrophication and high mineralization than the Lower Litani Basin. Moreover, the results clearly indicate an important role of Qaraoun dam in the reduction of the level of eutrophication and mineralization of Upper Litani Basin. In addition to this, Nehme et.al 2014, investigated the correlation of the physicochemical characteristics of the Litani Lower River, whereby eleven physical and chemical parameters were collected from six sites in the lower Litani basin during the months of May and July. The analysis of the measured parameters revealed a high concentration of nitrite detected in the basin. Due to the limestone nature of the rock, the carbonate exceeded the acceptable standard. Nehme et.al, 2020, assessed the groundwater water quality in the Lower Litani Basin. Water samples were collected from various locations of the study area. the study of groundwater in sites of the lower Litani were selected for undergoing physicochemical analysis of water parameters as T, PH, EC and TDS, anion content (NO3-, SO4 2-, C- and PO4 3-), cation content (Na+, K+, Ca2+,NH4 + and Mg2+), and the metal content of Cd, Cr, Fe, Pb, Cu and Zn. The observed microbiological parameters were: *Salmonella*, *E. coli*, Total coliforms, *Clostridium perfringens* and *Staphylococcus aureus*. Using PCA, the study indicated that the sites were not contaminated with magnesium, ammonium, sodium, potassium chloride and phosphate since their concentrations were generally below the standards set for the WHO. However, contamination by other elements was the case in some sites which showed concentrations higher than the acceptable limits. This pollution was revealed by nitrate, sulfate, calcium and bacteria. Microbial pollution was clearly visible in all investigated sites. This can be attributed to several factors such as domestic wastes, wastewater, tourist activities and rejections of the agricultural waste.

The aim of this study is to combine different indicators; Principal Component Analysis method (PCA) and Water Quallity Index method (WQI) to assess the water quality in Litani River Basin. PCA method will be used to correlate the different water quality parameters with the location of the pollution source. Also, it will enhance the understanding of the pollution spatial distribution. Then, the WQI will provide the stakeholders with the proper decision for the water usage either for drinking or irrigation purposes.

2. STUDY AREA DESCRIPTION

The study area shown in Figure 1 represents the Litani River basin trajectory where it rises in the Bekaa Valley from the Oleik spring west of the ancient city of Baalbeck and flows southward then westward till it reaches the Mediterranean Sea near the city of Tyre. The Litani River basin is divided into three sub-basins (Upper Litani Basin, Qaroun lake and Lower Litani Basin). The largest sub-basin is the Upper Basin, which covers about 1500 km^2 of the Bekaa valley and stretches from the river's source, at 1000 m elevation, to the Qaraoun dam, at an elevation of 850 to 800 meters above sea level (Amacha et. al 2018). The Qaraoun reservoir has a capacity of roughly 220 million cubic meters (MCM), with 160 MCM being used for irrigation and hydropower generation (Fadel et.al 2017). The Lower Litani Basin characterized by an average altitude of about 600 m and a population of around 133000 capita living in 104 communities, (Khoury et al. 2006). According to yearly rainfall data, the Litani river is divided into two main periods of precipitation: the upper Litani receives an average of 900 mm of precipitation each year, while the Lower Litani Basin receives an average of 700 mm (Litani River Authority, 2010).

The relatively wide size of the Litani river basin, which passes through a variety of terrain types with various uses (mostly agricultural), renders it sensitive to many elements of pollution (Haidar et al 2014). It receives considerable amounts of wastewater from the surrounding industrial areas as well as from intensively cultivated agricultural areas and domestic wastes from the surrounding towns and villages. Thus, the key to perform this study is the water quality data of the Litani River which are essential for understanding physicochemical and biological processes, and the spatial distribution of the pollutants along the river. The Litani River Authority (LRA) is the main association that is responsible for the River monitoring system. LRA faces various challenges associated with data collection and monitoring for the hydrologic sciences. However, LRA performs many data collection campaigns. The water quality data were collected from Baydoun et al., 2016 and LRA. Figure 1 shows the location of the monitoring sites. The available water quality data along the whole river was collected during the years 2013-2014 from Baydoun et.al 2016, as shown in Table 1. These data were collected from five stations which are Rayak, El Marj and Jib Janine (Litani Upper basin) and Delafi and Al kurdali (Litani Lower Basin). The LRA ,on the other hand, were collected during 2019 from four stations (AL Khurdali, Qaakait el Jsir, Al Zrarieh and Al Qasmieh), as shown in Table 2.

3. METHODLOGY

3.1 Principal Component Analysis (PCA)

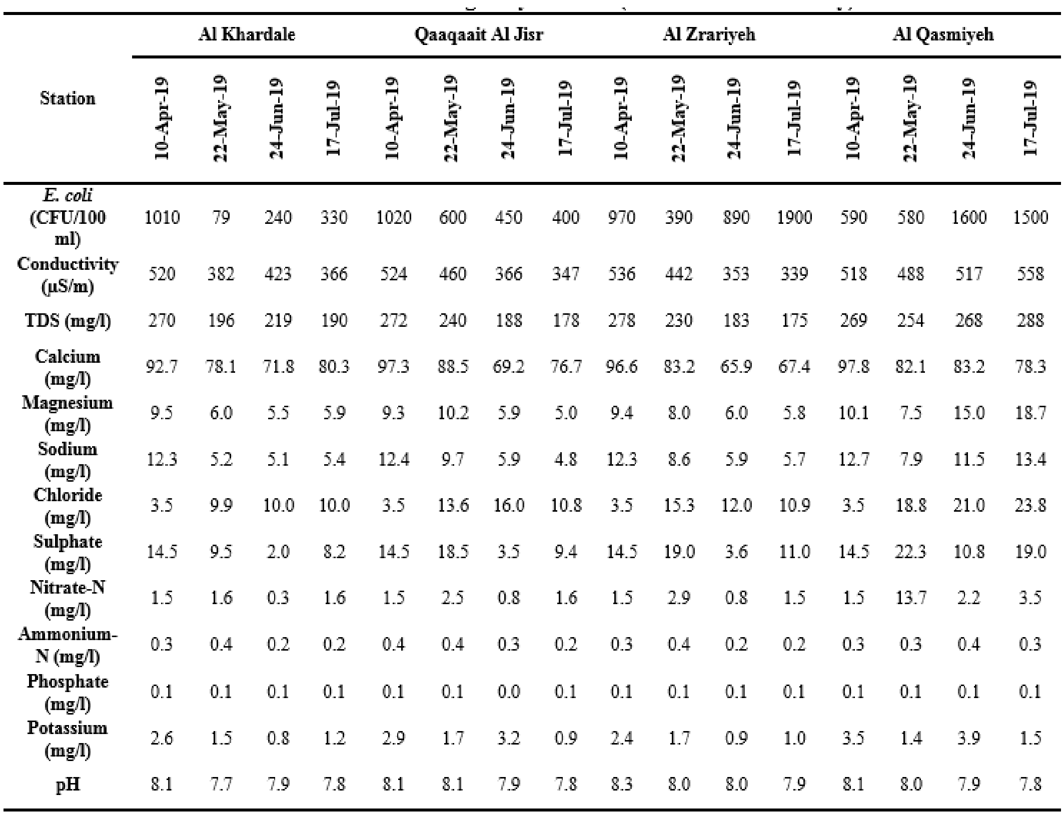
Monitoring database that consists of large number of sampling sites with numerous parameters for different time-period, cannot be effectively evaluated by using mathematical models because of the interrelationship among the parameters, sampling sites and time period. Principal Component Analysis, or PCA, is a dimensionality-reduction method that is often used to reduce the dimensionality of large data sets, by transforming a large set of variables into a smaller one that still contains most of the information in the large set. Several statistical software has been developed to perform PCA. In this study two statistical software which are SPSS (Kazi et al., 2009) and MiniTab (Tavakol et al., 2017) were used. Seventeen parameters were studied using Principal component analysis method to assess water quality and to determine the ecological status of the Litani River Basin. The studied parameters were, pH, Temperature, Conductivity, SD, Sulfate, Phosphate, Nitrite, Nitrate, Ammonia, Total Nitrogen, COD, BOD, Turbidity, TDS, DO, Salinity and velocity, as shown in table 1. The parameters were taken from five sites distributed along both the upper and lower river basins.

Principal component analysis method was used to assess water quality in these five sites between years 2013 and 2014. Figure 3 represents four sites in the Litani Lower Basin were selected. The Canadian water quality index method was used to evaluate the water quality in Litani Lower Basin for irrigation and drinking purposes for the year 2019.

Table 1. Average water quality parameters (2013-2014) (Baydoun et.al 2016)

Location	Rayak	El-Marj	Jeb Jenine	Dallefi	Khardali
pH	7.46	7.74	7.82	8.02	8.09
Temperature °C	20.75	22.12	23.03	19.91	21.87
Conductivity	1804.83	1129.44	635.00	341.85	333.63
SD (cm)	15.83	16.04	29.78	--	130.04
SO_4 (ppm)	20.88	18.89	33.70	10.56	10.44
PO_4 (ppm)	18.14	9.27	7.60	0.60	0.45
NO_2 (ppm)	0.33	0.38	0.67	0.28	0.30
NO_3 (ppm)	6.88	6.22	7.81	8.11	6.89
NH_3 (ppm)	38.23	33.97	9.82	0.23	0.22
Total Nitrogen (mg/l)	45.44	40.57	18.30	8.62	7.41
COD (mg/l)	504.49	284.66	69.34	20.92	15.80
BOD (mg/l)	7.75	6.39	2.89	1.52	1.91
Turbidity (ntu)	80.09	48.35	25.17	2.11	6.34
TDS (mg/l)	1258.79	788.30	443.74	230.89	242.74
DO (mg/l)	0.70	0.89	1.50	2.43	2.38
Salinity (mg/l)	896.33	565.07	318.33	176.59	166.30
Velocity (m/s)	0.32	0.15	0.30	0.12	1.35

Table 2: Physio-chemical and microbial Water quality parameters in Litani Lower Basin measured during the year 2019 (Litani River Authority)



Station	Al Khardale				Qaaqaait Al Jisr				Al Zrariyeh				Al Qasmiyeh			
	10-Apr-19	22-May-19	24-Jun-19	17-Jul-19	10-Apr-19	22-May-19	24-Jun-19	17-Jul-19	10-Apr-19	22-May-19	24-Jun-19	17-Jul-19	10-Apr-19	22-May-19	24-Jun-19	17-Jul-19
E. coli (CFU/100 ml)	1010	79	240	330	1020	600	450	400	970	390	890	1900	590	580	1600	1500
Conductivity (µS/m)	520	382	423	366	524	460	366	347	536	442	353	339	518	488	517	558
TDS (mg/l)	270	196	219	190	272	240	188	178	278	230	183	175	269	254	268	288
Calcium (mg/l)	92.7	78.1	71.8	80.3	97.3	88.5	69.2	76.7	96.6	83.2	65.9	67.4	97.8	82.1	83.2	78.3
Magnesium (mg/l)	9.5	6.0	5.5	5.9	9.3	10.2	5.9	5.0	9.4	8.0	6.0	5.8	10.1	7.5	15.0	18.7
Sodium (mg/l)	12.3	5.2	5.1	5.4	12.4	9.7	5.9	4.8	12.3	8.6	5.9	5.7	12.7	7.9	11.5	13.4
Chloride (mg/l)	3.5	9.9	10.0	10.0	3.5	13.6	16.0	10.8	3.5	15.3	12.0	10.9	3.5	18.8	21.0	23.8
Sulphate (mg/l)	14.5	9.5	2.0	8.2	14.5	18.5	3.5	9.4	14.5	19.0	3.6	11.0	14.5	22.3	10.8	19.0
Nitrate-N (mg/l)	1.5	1.6	0.3	1.6	1.5	2.5	0.8	1.6	1.5	2.9	0.8	1.5	1.5	13.7	2.2	3.5
Ammonium-N (mg/l)	0.3	0.4	0.2	0.2	0.4	0.4	0.3	0.2	0.3	0.4	0.2	0.2	0.3	0.3	0.4	0.3
Phosphate (mg/l)	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Potassium (mg/l)	2.6	1.5	0.8	1.2	2.9	1.7	3.2	0.9	2.4	1.7	0.9	1.0	3.5	1.4	3.9	1.5
pH	8.1	7.7	7.9	7.8	8.1	8.1	7.9	7.8	8.3	8.0	8.0	7.9	8.1	8.0	7.9	7.8

3.2 Water Quality Index WQI

Several irrigation and potable water projects have been developed in the Litani Lower Basin area. These projects rely basically on Litani River in supplying water for agricultural lands and potable water for villages along Litani Lower Basin. Unfortunately, no tests have been performed on Litani River to check its suitability for irrigation or drinking usage. Therefore, CCCME WQI was used as tool to assess water quality in the Litani Lower Basin for irrigation and drinking purposes. The Canadian Council of Ministers of the Environment (CCME) Water Quality Index (WQI) developed to simplify the reporting of water quality data. It is a tool for generating meaningful summaries of water quality data and is useful for technicians and policy makers, as well as the public interested in water quality results. It provides a comprehensive overview of water quality data and is not a substitute for detailed analysis of water quality data. Table 2 Shows the used Physio-chemical and microbial Water quality parameters that measured in four stations in the Litani Lower Basin during the year 2019. All data was obtained from the Litani River Authority.

The CCME WQI model consists of three measures of variance from selected water quality objectives (Scope F1; Frequency F2; Amplitude F3). These three measures of variance combine to produce a value between 0 and 100 that represents the overall water quality. According to the Canadian model (Khan et. al 2005), water quality is divided into the following categories: High-quality water (95-100): Water quality is protected with a virtual absence threat, Good-quality water (80-94): Water quality is protected with only a minor threat, Fair-qualified water (65-79): Water quality is protected but occasionally threatened, Marginal water quality (45-64): Water quality is frequently threatened, and Poor-quality water (0-44): Water quality is almost always threatened. The detailed formulation of the WQI, as described in the Canadian Water Quality Index is as follows:

Scope (F1) represents the percentage of parameters that do not meet their guidelines at least once during the time period under consideration ("failed parameters"), relative to the total number of parameters measured:

$$F_1 = \left(\frac{\text{Number of failed parameters}}{\text{Total number of parameters}} \right) \times 100$$

Frequency (F2) represents the percentage of individual tests that do not meet guidelines ("failed tests"):

$$F_2 = \left(\frac{\text{Number of failed tests}}{\text{Total number of tests}} \right) \times 100$$

Amplitude (F3) represents the amount by which failed test values do not meet their guidelines and is calculated in three steps.

3.2.1 Calculation of Excursion:

The number of times by which an individual concentration is greater than (or less than, when the guideline is a minimum) the guideline is termed an "excursion" and is expressed as follows. When the test value must not exceed the guideline:

$$excursion_i = \left(\frac{FailedTestValue_i}{Objective_j} \right) - 1$$

For the cases in which the test value must not fall below the guideline:

$$excursion_i = \left(\frac{Objective_j}{FailedTestValue_i} \right) - 1$$

The collective amount by which individual tests are out of compliance is calculated by summing the excursions of individual tests from their guidelines and dividing by the total number of tests (both those meeting guidelines and those not meeting guidelines). This parameter, referred to as the normalized sum of excursions, or nse, is calculated as

3.2.2 Calculation of Normalized Sum of Excursions

The normalized sum of excursions, nse, is the collective amount by which individual tests are out of compliance. This is calculated by summing the excursions of individual tests from their objectives and dividing by the total number of tests (both those meeting objectives and those not meeting objectives)

$$nse = \frac{\sum_{i=1}^{n} excursion_i}{\#\ of\ tests}$$

3.2.3 F3 is calculated by an asymptotic function that scales the normalized sum of the excursions from objectives to yield a range from 0 to 100

$$F_3 = \left(\frac{nse}{0.01nse + 0.01} \right)$$

The CCME WQI is then calculated as:

$$CCMEWQI = 100 - \left(\frac{\sqrt{F_1^{\,2} + F_2^{\,2} + F_3^{\,2}}}{1.732} \right)$$

By this process the CCME WQI converts raw WQ data into information (how many parameters exceeded the guidelines, how frequently and by what amplitude) and then into knowledge (the water is Excellent, Good, Fair or Poor for drinking water use etc.) Table 3 shows the CCME WQI categorization schema.

4. RESULTS AND DISCUSSION

PCA could reduce the dimensionality of the water quality data sets into two major principal components (i.e., PC1 and PC2). Figure 2 represents the water quality parameters loadings and correlation between them. The X-axis represents the principal component 1 (PC1) with a 40.1% variance while Y-axis represent the principal component 2 (PC2) with a 12.4% variance. In right side of figure 2 the parameters conductivity, TDS, Turbidity, Total Nitrogen, phosphate, COD and ammonia are highly correlated with each other having a loading above of 0.5. On the other side of the x-axis DO and pH are also highly correlated with loading above of 0.5. The correlation of ammonia, Turbidity and COD is considered to be an indicator of water contamination since the rise of ammonia levels beyond health limits may be harmful and toxic to fish and aquatic organisms. Also, the presence of COD indicates greater amount of oxidizable organic material which reduces DO levels which is important for aquatic life. Turbidity affects the growth rate of algae because increased turbidity causes a decrease in the amount of light for photosynthesis triggering also DO depletion. The other side of the X-axis shows the DO which is very important for aquatic life and aquatic organisms while pH existence reflects the availability of nutrients and biological functions. All these factors are a significant proof on pollutant agricultural and industrial drainage into the river. Figure 3 represents the cluster analysis that demonstrates the correlation between river sites affected by pollution along the River based on the studied water quality parameters using PCA. For PC1 the correlated stations are Rayak and El Marj which are located in the upper Litani Basin. On the other side the correlated stations are Dallafi and AL kurdali located in the Lower Litani Basin. For PC2, Jib-Jenin station is individualized and located in the middle as a buffer zone. The PCA results clearly indicate that the Upper Litani Basin is characterized eutrophication and high mineralization indicating water contamination while Lower Litani basin is characterized by presence of higher dissolved oxygen values which indicate better water quality. Moreover, they conclude the important role of Qaroun Reservoir in reducing the level of eutrophication and mineralization of the upper Liatani Basin. As a result, it is recommended to use the water after the natural purification happens at Qaroun Reservoir.

Consequently, water quality at Lewer Litani Basin should be examined in order to check its availability for drinking and irrigation. The calculation results of WQI for drinking and irrigation purposes are shown in Figure 4. WQI values for drinking water were found approximately 40 at all the stations thus water quality is Poor, almost threatened and impairment conditions usually depart from natural and desirable conditions according to the CCME categorization schema. On the other hand, the calculation results of WQI for irrigation purpose show that WQI index values ranged between 86 and 92. Hence the results clearly indicate that the water quality rank is Good at the four stations and it is protected with a minor degree of impairment. Almost all physical and chemical parameters used in calculating water quality index for irrigation and drinking water were below the permissible limits of FAO, WHO but Microbiological parameters (*E. coli*) showed a high difference especially in drinking water permissible limit as per French guidelines and WHO. Previous Studies (Haydar et al., 2014) performed on analyzing water quality in the Litani Lower basin has indicated the presence of microbial parameters in high levels which might be due to domestic wastes and wastewater as well as tourist activities. Other studies also indicated the presence of high concentration of metals specially in dry season such as Fe, Cd, Ni, and Cr. Thus, the results obtained supports the existence of contamination in the Litani Lower basin by microbial parameters. Also, CCME WQI method results coincide with other studies (Baydoun et al. 2016) performed on the Litani Lower Basins and agrees that the Lower Litani is less contaminated than the upper Litani. Thus, it can be used for irrigation but not for drinking purposes due to microbial contamination. Furthermore, physio-chemical parameters shall not be ignored even if they are below the permissible levels since some studies (Baydoun et al., 2016), (Nehme et al., 2014), (Haydar et.al.,2014) has indicated that some areas of the Litani Lower River were contaminated with agricultural runoffs, fertilizers and municipal wastes in dry seasons. Moreover, microbial contamination is a serious challenge facing drinking water projects in Litani Lower Basin. One example of these projects is Al Khurdali Reservoir project. The Project intends to use Litani Lower Basin water as potable water to supply secure potable water (9 Mm^3) to villages situated between 400- and 150-m elevation. Therefore, it is extremely important to take an immediate action to ensure safe drinking water. Immediate actions should be taken to resolve microbiological contamination in Litani Lower basin in order to perverse water for irrigation activities and to secure water for supplying drinking water and include:

1. Constructing Chlorine water treatment plants to treat microbiological parameters such as *E. coli* in order to ensure the suitability of water for drinking.
2. Maintain an appropriate infrastructure for villages surrounding the Litani Lower Basin to prevent discharging of grey water into the river.
3. promote awareness for local communities, farmers, tourists etc. on the importance of Litani Lower Basin as an important water resource for agricultural and drinking purpose.
4. Develop and apply environmental policies and legislations to prevent any kind of excesses on Litani Lower basin.

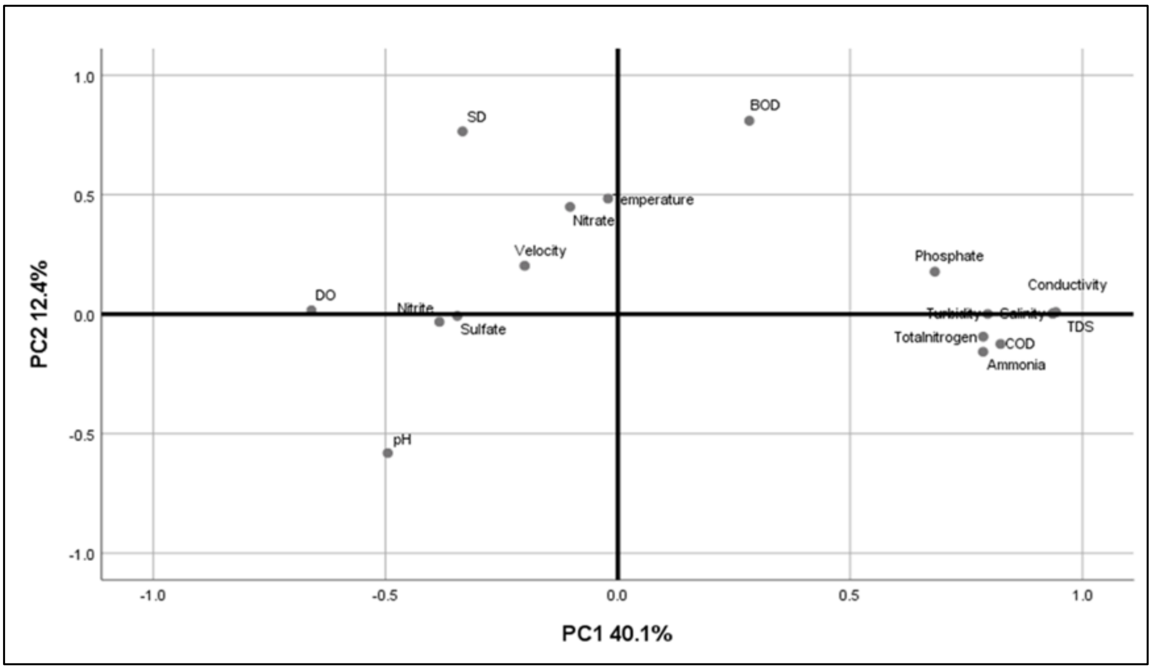


Fig.2: Multivariate Analysis of Water Quality Parameters for Litani River: Principal Component Analysis

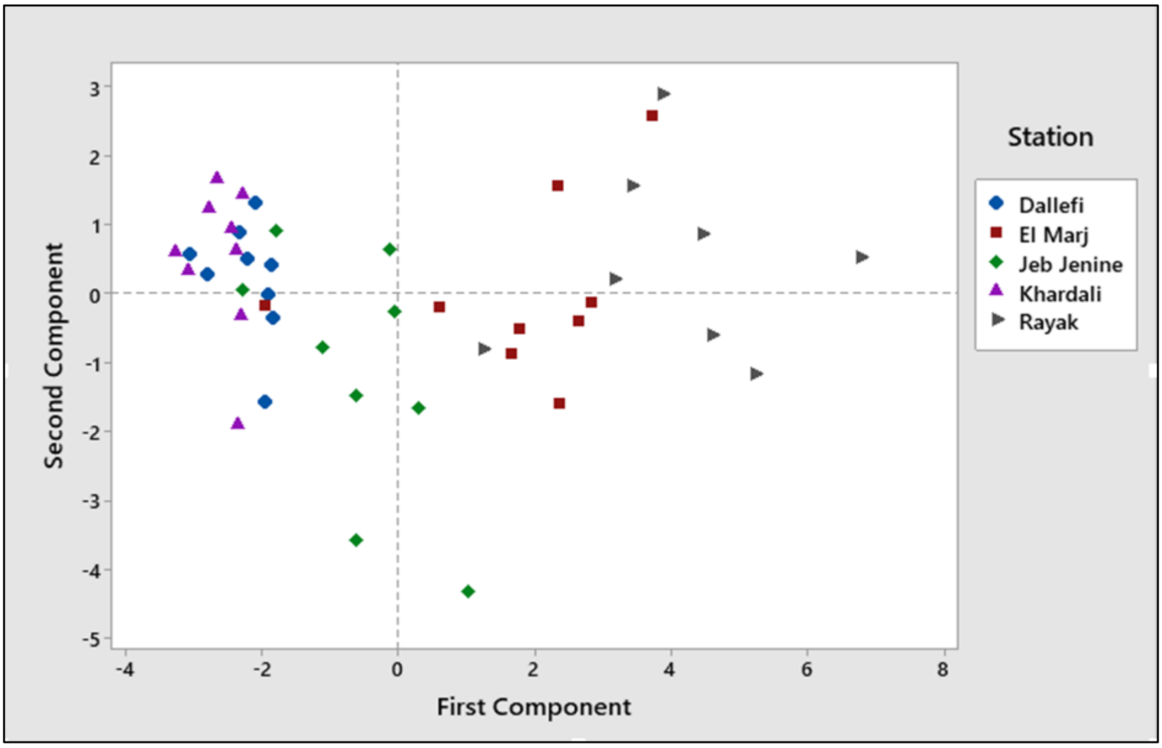


Fig.3: Multivariate Analysis of Water Quality Parameters for Litani River: Cluster Analysis

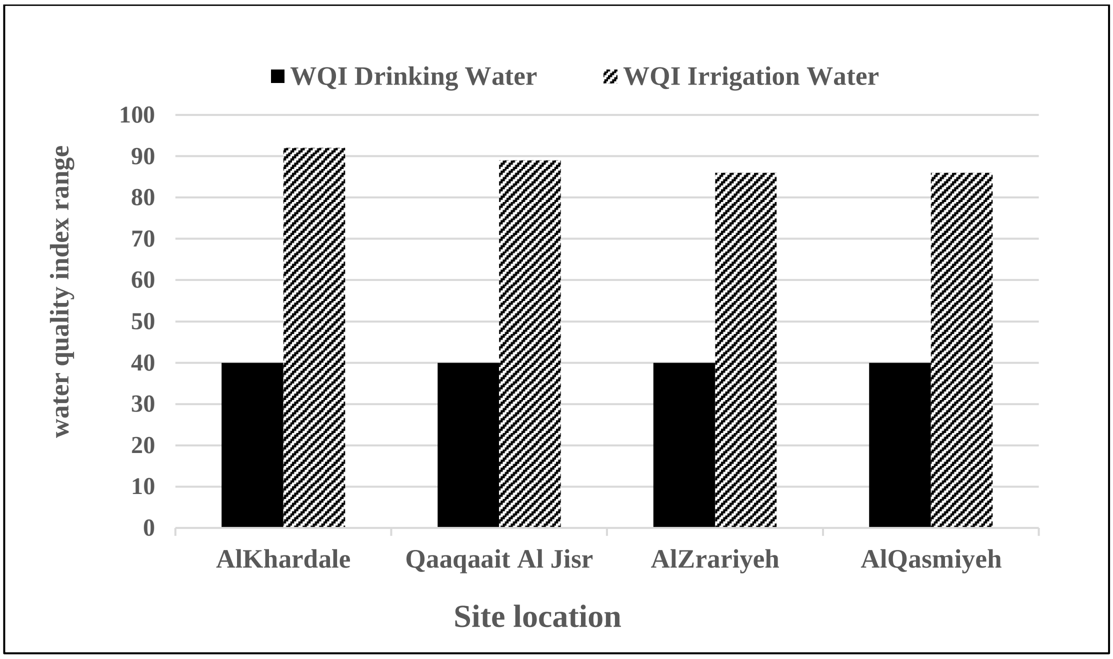


Fig.4: CCME WQI for Lower Litani Basin for drinking and irrigation purposes

5. CONCLUSION

In this study a combination between Principal Component Analysis method (PCA) and Water Quality Index method (WQI) is used to assess the Litani River Basin water quality. PCA results clearly indicate that Upper Litani River characterized by eutrophication and mineralization, while the Lower Litani River had a better water quality highlighting the role of Qaraoun Dam in reducing the eutrophication level in the Lower River. Therefore, it is recommended to use the water after the natural purification happens at Qaroun Reservoir. As a result, the water quality along the Lower Litani River is graded to prove its convenience for different uses. The WQI calculated in Lower Litani River revealed that water quality index for irrigation purposes and drinking purposes were Good and Poor in all stations according to CCME schema table, respectively. Microbial contamination is found to be the key factor in determining WQI results for agricultural and drinking purposes. *E. coli*counts are always above the permissible limits which is 250 CFU/100ml for irrigation purposes in French guidelines and 1CFU/100ml for drinking according to WHO. Stakeholders should take immediate actions to resolve microbiological contamination in Litani Lower River in order to perverse its water for irrigation activities and supplying drinking water.

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