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Nexus Assessment of Water, Food and Health in the 19th District of Tehran

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Abstract
One of the most complicated industrial processes in today's world is the interaction known as the Nexus term which is between WSW, soil, water, and waste. Accordingly, the main objective of this research is to achieve a network model that can be used to determine the status of hazards with use wastewater and sewage for irrigation of agricultural land. This is an experimental-laboratory study. The methodology incorporates six main stages: Recognition of the studied area, Quantitative and qualitative assessment of surface and underground water, Determination of stability indicators and interlinkages matrices, valuation of interventionists, Comparison of interventions, and Management solutions. Results on the water quality index showed that surface water contamination at 14 sampling point was medium to very bad.57 percent of surface water points have high pollution,36 percent are relatively bad and 7 percent have a moderate pollution index. The results of measurement of metals in the territory of district 19 show the highest pressure in the first stage of agriculture and the next step that only four parameters of barium, lead, vanadium and zinc in some places are more than the standards of the countries environmental protection organization. According to the Nexus radar chart, the highest pressure caused by the presence of pollution in the first stage on agricultural products and in the nexus step, on the health of that area.

Keywords: Nexus, Sewage, Irrigation, Agriculture, Assessment.

Introduction

Reduction of water resources in climate change, community's critical need for drinking, agriculture and industry, sharp decrease of water for agriculture in urban and rural areas, the use of wastewater and sewage in urban areas, and settlements of rural areas are inevitable consequences for the cultivation of agricultural products (Hettiarachchi et al., 2018). The use of urban and rural wastewater and sewage can lead to significant risks to human health and the environment. However, due to lack of water resources to supply for agricultural activities, especially in cities of developing countries, the use of urban wastewater and sewage is one of the concerns of organizations and bodies responsible for health and the environment. (Endo, et al. 2017). Therefore, the main issues concern the use of urban wastewater and wastewater in

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irrigating agricultural land for agricultural production, especially vegetables, vegetable and peri-urban gardens, managing the risks of irrigation with wastewater and sewage due to the physical, chemical, and biological contamination of farm products. Less vulnerable to the continuing outcomes of such water, farmers reduce the pollution of biological resources such as soil and groundwater.

The use of raw and refined wastewater in different countries of the world has long been common. Since the middle of the nineteenth century and the onset of bacterial contamination in the surface water resources of industrialized countries (especially in Europe and the United States), which had widespread health issues, various wastewater treatment plants developed gradually in different urban areas. This development has been expanded worldwide by the end of the twentieth century, due to increased water demand for agriculture (Garcia and Pargament, 2015). So far, myriads of waste disposal projects in agricultural fields and many pertinent studies have been widely conducted on quantitative and qualitative urban wastewater assessment.

The 19th district of Tehran has a special place in the area of the south entrance of Tehran and has some of the structural elements of the city. The area comprises 5 regions, the four and five of which are mainly industrial and agricultural. Agriculture in district 19 has a long history. The 3, 4 and 5 regions are not connected to the urban sewage system. Disposal of household waste and wastewater, while creating environmental pollution at the level of these neighborhoods and decreasing the level of residents' health, due to its mixing with the passageways used for irrigation of agricultural land for all individuals of the community are unknowingly and routinely providing vegetables to farmers, causing an outbreak of diseases and irreparable dangers. Therefore, considering the importance of water pollution assessment used for irrigation of agricultural products in 19th District of Tehran Municipality, the objectives of this study are 1. Estimation of the amount of surface and ground runoff pollution; 2. Spatial distribution of pollution; and 3. Identification of potential sources under pressure and risks 4. providing management solutions based on the Nexus assessment.

Materials and Methods

Study area and sampling points: The sample population was studied after a general review of the collection and disposal of surface water and canals of agricultural lands and field visits, in cooperation with Tehran's 19th district, including 14 points of surface water canals and 7 points of wells in Tehran's 19th district. Figure 2 shows the points of selection and the distribution of points at the level of area 19. Sampling was done for water for surface water on April 29th, 2000 and underground water on February 13th.

The target sites for soil sampling and monitoring the heavy metal pollutants and organic pollutants existed in the soil of the 19th district of Tehran are proposed in this section.

Point 1: Inside the boostan-e Vellayat, Point 2: Saeedi highway, Point 3: residential area park, Point 4: Waste removal and recycling in Khalazil, Point 5: Brick furnaces and Concrete plant, Point 6: Place of discharge and Point-7: the border of the Azadegan highway (replaced), point 8: Khalazil agricultural land, point 9: workshops for construction and occupation, points 10 and 11: Plaeen range (point 11 replaced), Point 12: Atkaa Agricultural Complex, Point 13: Livestock in Qal'e Nou District (replaced), Point 14: Jafarabad Agricultural Land.

Methodology: This is an experimental-laboratory study and from six main stages 1-Recognition of the studied area; 2. Quantitative and qualitative assessment of surface and underground water; 3- Determination of stability indices and interlinkages matrices, 4. Intervention assessors, 5, comparison of interventions and 6-management solutions (Daher et al., 2017; Padash, 2017).

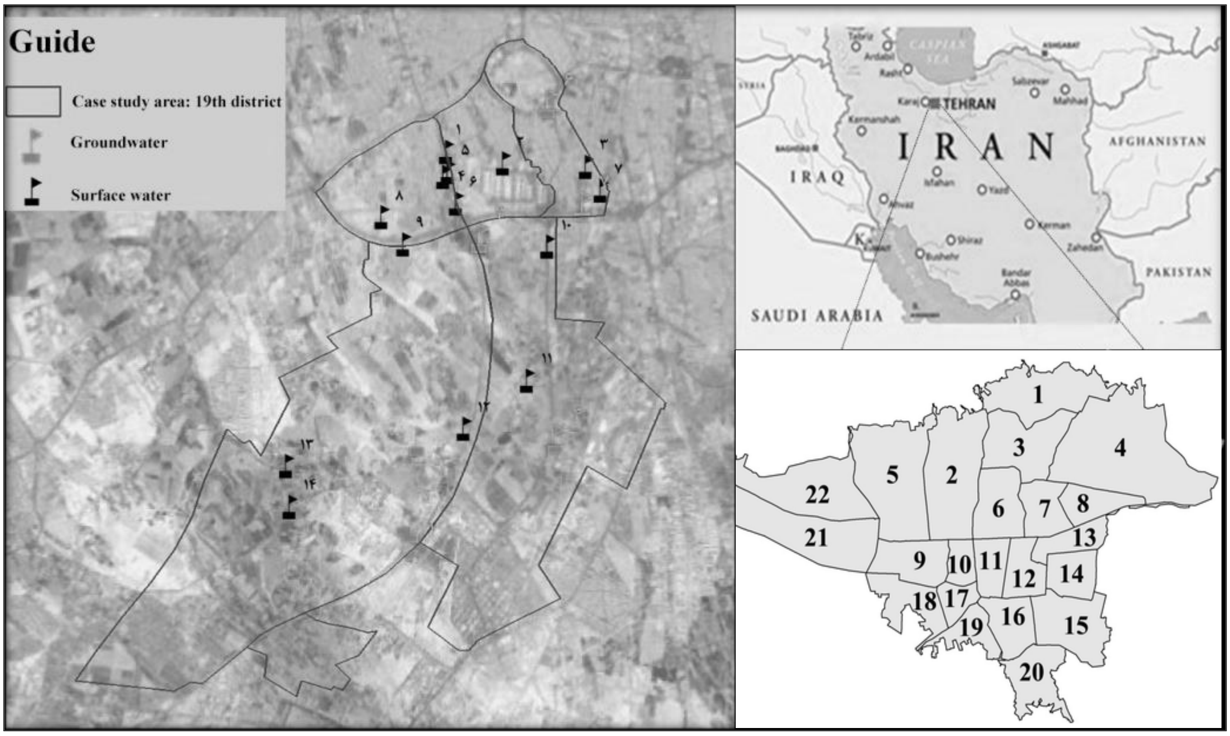

Figure 1. Surface and underground water sampling points in the south of Tehran (19th District of Tehran)

Table 1. Surface and underground water sampling points

Ground water sampling point	Surface Water sampling points	
1-East Water Tank	1-Shahid Kazmi-North	8-Azadegan-Shaghayegh
2-Toba Forest Water	2-Motahari	9-Azadegan
3-Afra Forest Well	3-North Bahmanyar	10-Kalhor
4-Akhlaghi Water Well	4-Ahmadieh Town 1	11-Ghale No-Bala Dast
5-Water tank Kashalut	5-Ahmadieh Town 2	12-Ghale No-Paeen dast
6-Water Wells of Velayat Garden	6-South Shahid Kazemi	13-Upper Kan river
7-Water Wells of Behesht Park	7-South Bahmanyar	14-Downer Kan river

Table 2. Plant sampling points

Sample	Sample type	Address
1	Basil	District 3
2	Leek and parsley	Ahmadiyeh city
3	Radish	Saleh Abad
4	Mint	Azadegan around

Quantitative and qualitative assessment: Surface water and underground water: Determination of water quality measurement and measurement parameters: Parameters for the assessment of surface water and underground water quality in accordance with the Environmental Protection Agency standard (Table 3) and for each sampling point measurement. After the measurement, all parameters were compared to the standards of the Water and Energy Engineering Department of the Ministry of Energy and their changes to the limit were considered (Yousefi et al., 2018; Alami et al., 2018).

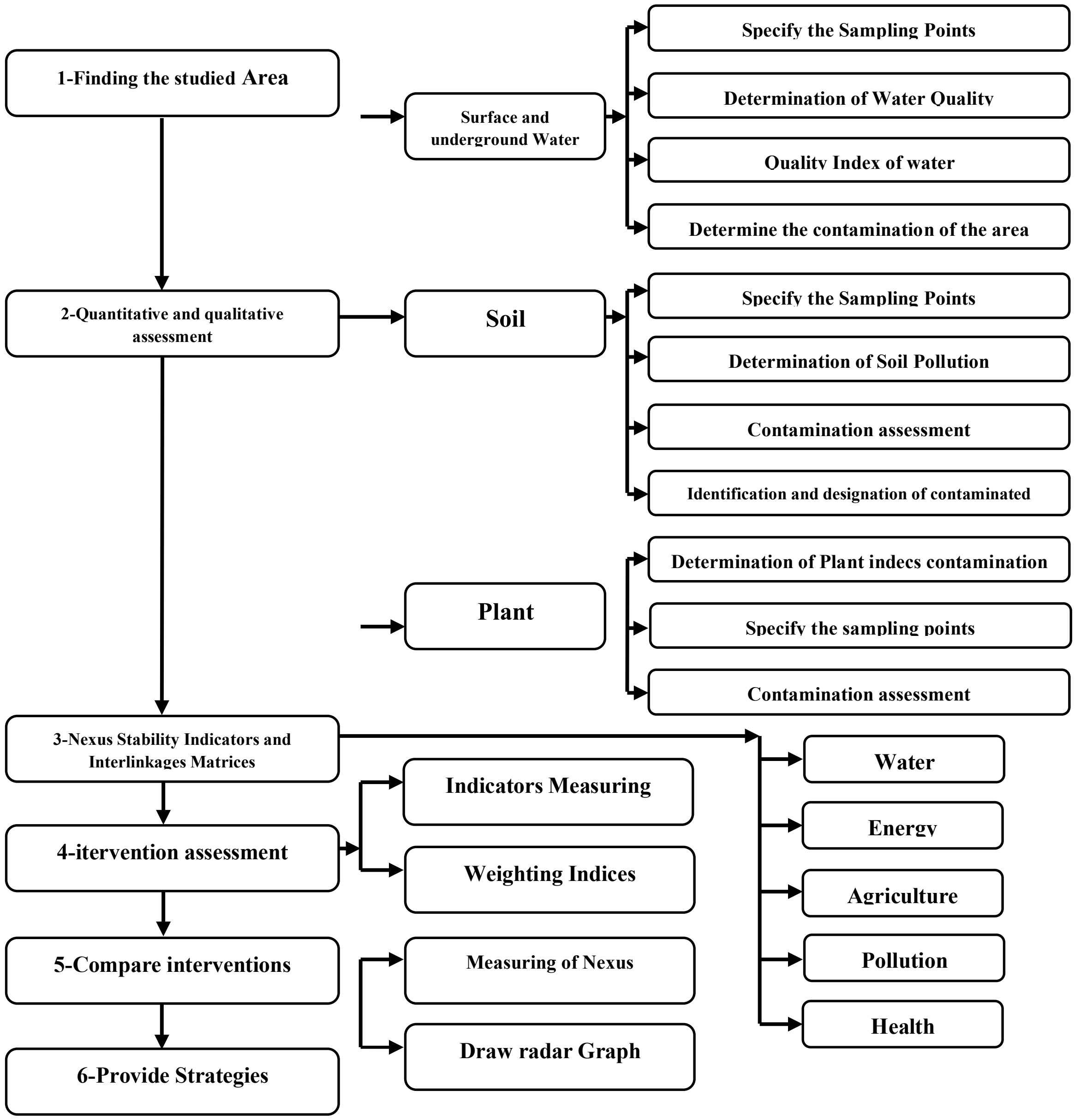

Figure 2. Methodology of Surface Water and Groundwater Quality Index (WQI) Evaluation in South of Tehran for Agricultural Use

Surface Water and Sub-Surface Water Quality Indicator: The Surface Water and Groundwater Quality Index of the study area were evaluated based on QWI. This index is a convenient and simple tool for determining the status and quality of water, in which data of several parameters of water quality are included in a mathematical formula that shows the water's health with a number. This number is categorized by a relative scale indicating that the quality of water is very bad to excellent (Hettiarachchi, and Ardakanian, 2016). Stages of calculating the index and the common parameters of the quality of surface water and groundwater resources are: selecting parameters, determining the weight of each parameter (Table 4), and obtaining the value of each indicator for each parameter using the ranking curve (1 and 2 equations).

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Table 3. Parameters measured by common contamination of surface water and underground water

Row	Parameter	Description	Underground water	Surface water
1	Fecal coliform	MPN/100ml	✓	✓
2	BOD5	Milligrams per liter	-	✓
3	Nitrate	Milligrams per liter	✓	✓
4	Dissolved oxygen	Percent saturation	✓	✓
5	Electrical conductivity	micro Siemens per cm	✓	✓
6	COD	Milligrams per liter	-	✓
7	Ammonium	Milligrams per liter	-	✓
8	Phosphate	Milligrams per liter	✓	✓
9	Opacity	According to NTU	-	✓
10	Total hardness	In mg / l of calcium carbonate	✓	✓
11	pH	Standard unit	✓	✓
12	SAR	Milligrams per liter	✓	-

Table 4. Measured parameters of common contamination of the index and their weights in surface water (IRWQI SC and groundwater (IRWQI GC)

Row	Parameter	Weight for underground water	Weight for surface water
1	Fecal coliform	0.134	0.140
2	BOD5	-	0.117
3	Nitrate	0.151	0.108
4	Dissolved oxygen	0.67	0.97
5	Electrical conductivity	0.129	0.96
6	COD	-	0..93
7	Ammonium	-	0.90
8	Phosphate	0.85	0.87
9	Opacity	-	0.62
10	Total hardness	0.103	0.59
11	pH	0.51	0.51
12	SAR	0.89	-

$$IRWQI(SC\ or\ GC) = \left[\prod_{i=1}^{n} I_i^{wi}\right]^{\frac{1}{y}} \quad (1)$$

$$\gamma = \sum_{i=1}^{n} W_i \quad (2)$$

where: Wi = weight of parameter i, n = number of parameters, I = the index value for the i- th parameter of the ranking curve.

Determination of Pollution Areas: After calculating the indexes, Table 4 has been used to determine the descriptive equivalent of the calculated index.

Table 5- Determination of descriptive index equivalent

Descriptive equivalent	Indicator value
very bad	Less than 15
Bad	15.9-29
Rather bad	30.9-44
Medium	45-55
Fairly good	55.77-1
Good	70-85-1
very good	More than 1

Soil Pollution Evaluation Method, Nemerow Index: In order to study the soil quality in this area, the Nemerow combination index method has been used. The basis of this method is the application of a single contaminant index in accordance with equation 3 to affect each of the pollutants in the final evaluation of their complex (Kurian and Ardakanian, 2016)

$$(Pi) = Ci/Cref \tag{3}$$

In this regard, Pi is a single indicator of contamination, Ci is the concentration of contaminants at the monitoring point and Cref is the permissible concentration of pollutant according to the standard (Soil Quality Standard of Iranian Environmental Organization). Since the Iranian standard has set the permissible values more stringent than international standards, using this index with Iran's standard values is in order to be reliable and reasonable.

After the calculation of the individual index for each pollutant, the Nemerow combination index, following 3-6, applies the effect of all the contaminating parameters in the calculation.

$$(P_s) = \sqrt{(P_{ave}^2 + P_{max}^2)\ /\ 2} \tag{4}$$

Here, Pave is the mean of individual pollution indices and Pmax is the maximum value of the single index of contamination. Finally, the quality of soil environment according to the Nemerow combination index in the five groups is described in Table 6.

Table 6. PS values and the corresponding concept in the Nemerow index for soil contamination with heavy metals

Physical Context (Oral Variable)	P_s index value
Safe Range, No Risk	$P_s < 0.7$
Precautionary Range	$0.7 \leq P_s < 1$
Low contamination range	$1 \leq P_s < 2$
Relatively infected range	$2 \leq P_s < 3$
Highly infected area	$3 \leq P_s$

Interlinkages matrices and sustainability indicators Nexus

In a Nexus analysis, water, energy and food together with the quality of water, soil, health, as the internal parts of the resources, play a decisive role in its integrated analysis (Hettiarachchi et al., 2018). Therefore, the second step of the methodology, determines the drawing of three-dimensional matrices and stability indicators for analyzing the internal relation between the components of the Nexus including water (wastewater and groundwater), food (agricultural products), and health. This step determines to what extent environmental and social resources are under pressure due to pollution of the wastewater and soil.

The FAO in 2017 (Dawoud, 2017), has divided countries into four groups for the Nexus Accurate Analysis as follows. In this grouping, Iran and the study area are in the first group.

1. Agricultural countries in arid regions
2. Agricultural-centered countries in areas with rich water resources
3. Rich country with limited natural resources
4. Countries with transitional changes with high population growth

Sustainability Indicators: Based on the matrices of the previous clause, sustainability indicators were determined in five groups of water, agriculture, energy, pollution and health:

1. Water
   • Total water used for vegetable and vegetable production in 19th district (product in water used for seafood)
   • Total refined water
2. Energy
   • Total energy for irrigated lands
3. Agriculture
   • Percentage of irrigated land with waste / product:
4. Contamination
   • Percentage of polluted areas by wastewater pollutants / area
   • The percentage of polluted areas by contaminated soils
5. Healt`h
   • The risk of water consumption for products
   • Percentage of risk in terms of total pollutants

Assessing and comparing interventionists

Interveners have different outcomes in terms of the performance of local systems in pressure systems according to their performance. Therefore, after determining the sustainability indicators, in this section, each of them was compared to the desired state of the country (Ministry of Energy and the Environmental Protection Agency). Evaluation of the measured values is according to equations 5 and 6.

$$c - r = x \qquad (5)$$

c: measured value, r: optimal amount

$$d = \frac{x}{r}\% \qquad (6)$$

d: The difference between the measured and desirable values

The weight of each indicator was determined according to the expert opinion and the FAO standard, and the reference weight is calculated according to Table 7:

Table 7. Reference Weighting Indicators

D	Weight
+100≥	5
0.50	4
0.0	3
0.50-	2
-100≤	1
n/a	0

After calculating each of the above values, the importance of the main components of the Nexus is evaluated by the radar chart (Mannschatz et al., 2016). Radar graphing is a chart diagram or chart graphic that illustrates the status of the various variables required by displaying one or more polygons. By observing the radar chart, the importance and similarity of homogeneous variables can be understood in a Nexus analysis (Fig. 4)

Table 5. Results from surface water quality measurement

Points of Sampling	gastro enteric form Cali	BOD	COD	Total phosphate	Ammonium	Nitrate	Total hardness	Electrical conductivity	DO	Opacity	PH
North Shahid Kazemi	1100	18	37	0.17	0.53	19	530	1438	6.6	16.2	7.07
Motahari	2400	85	162	2.53	0.46	27	390	1311	5.5	-	7.27
North Bahmanyar	2400	12	19	0.08	0.02	23	140	556	5.8	2.34	7.36
Ahmadiyeh city	2400	164	284	2.39	5.41	27	270	1236	5.2	-	7.24
Ahmadiyeh city	2400	88	163	0.75	5.28	28	420	1089	5.9	-	7.39
South Shahid Kazemi	4660	4	8	0.27	0.36	18	480	1217	6.9	19.7	7.13
South Bahmanyar	2400	16	31	0.11	0.02	21	190	605	6.2	6.4	7.4
Azadegan - Shaghayegh	2400	86	160	0.56	2.36	21	290	1022	5.1	40.8	7.25
Azadegan	2400	104	159	1.88	1.68	24	300	961	5.6	48.1	7.23
Kalhor	2400	91	162	1.96	4.89	30	240	786	4.3	-	7.1
Ghale No-Bala dast	120	-	-	0.06	0.02	23	420	1238	6.2	1.24	7.51
Ghale No-Paien dast	120	-	-	0.05	0.02	24	410	1095	6.5	1.16	7.48
Upper handed of Kan river	2400	81	157	1.05	0.44	31	230	1025	5.4	-	7.42
Lower handed of kan river	2400	74	137	2.79	0.5	32	240	1151	5.1	-	7.38
Standard	400	31	200	50	1.5	45	500	700	2	50	8.4-6.5

According to Table 4 and Figure 3 for surface water, pH, turbidity, phosphate at 14 target points is less than the limit. In terms of organic parameters, the organic parameter, with the exception of four points of northern and southern Kazemi and South and North and South Behnamir, is more than the others (31) and Ahmediye 1 with 164 mg / l, the highest rate of infection in the area. The cod parameter is only greater than the Ahmadiyeh 1 and the remaining points are less than the set limit of 200. Among the organic indices, the organic parameter is the most important biochemical degradable organic matter measurement tool that is commonly used in sewage. The more oxygen needed, the greater the concentration of organic matter in the sewage that bacteria can oxidize(Scanlon et al., 2017). The total amount of gastrointestinal form except in the upper and lower parts of the castle in other parts of the area is higher than the permissible level and the highest rate is related to the point of the South Shahid Kazemi (4660 MPN / 100ml). From dissolved oxygen, all target points are allowed above the level.

In the water qualitative discussion, the most important criterion to consider is the electrical conductivity of water, which is a good indicator of the concentration of total soluble salts. This indicator determines water absorption and availability of water for the plant, and the main purpose of irrigation in each farm is increasing the available water of the plant. According to the survey, the electrical conductivity, except in northern and southern Bahmanyar, in other target areas is higher than the limit. Regarding the ammonium parameter, the highest rate of infection was observed in Ahmadiyeh 1 (5.41 mg / L), Ahmediyeh 2 (5.28 mg / L), Kalhor (4.89 mg / L), Azadegan-Shaghayegh (2.36 mg / Grams per liter) and freckles (1.68 mg / l). In other areas, the measured ammonium content was below the limit (University of Tehran, 2016).

Table 8 and Figure 3 describe the measured values for underground water quality in District 19 at the 7 points of the target and compare them with the permissible limit for the Water and Wastewater Engineering Department of Energy.

Water Quality Assessment Index (QWI)

QWI has been used to evaluate the water quality of many waters around the world. It aims to transform complex water-quality data into intelligible and practical information. This index reduces a large amount of data on chemical, physical and biological parameters of water in a simple way to a single number, which is the main advantage. The number with a relative scale, indicating the quality of water from the very bad to the highest, is the category (Elgallal, et al. 2016). The purpose of the water quality assessment in District 19 of Tehran Municipality is to provide an understanding about surface and groundwater contamination in the region. Among the parameters of surface water quality assessment in the study area, fecal coliform, electrical conductivity, dissolved oxygen and ammonium bod had the highest volume of contamination, which had the highest weight in the ranking curve. Therefore, surface water pollution in 19th district had the highest effect. Kazemi highway canals, Motahari, Bahmaniar and Kalhor avenues pass through residential areas. According to the qualitative index for samples taken from this channal (relatively bad), as well as the presence of high levels of foliar coliform and nitrate in samples, the unauthorized discharging of the sewage to this channel is likely. The agricultural land utilization channels in the Ahmadiyeh also have similar conditions, and apparently they have domestic sewage drainage. The Azadegan canal crossing the Shaghaygh Street also crosses the residential areas of District 3 and eventually departs to Azadgan Freeway Channel. Depending on the quality index and the analysis of the sample taken from this channel, it is probable to drain the household sewage. In addition, due to the imagination of this canal on the Azadegan highway canal, this issue can be a reason for the pollution of the Azadegan canal. The river in the 4th district crosses the residential areas upstream and down the quadrant of the town. Due to the lack of suitable sewage collection network, the sewage discharge into the river is not far (University of Tehran, 2016).

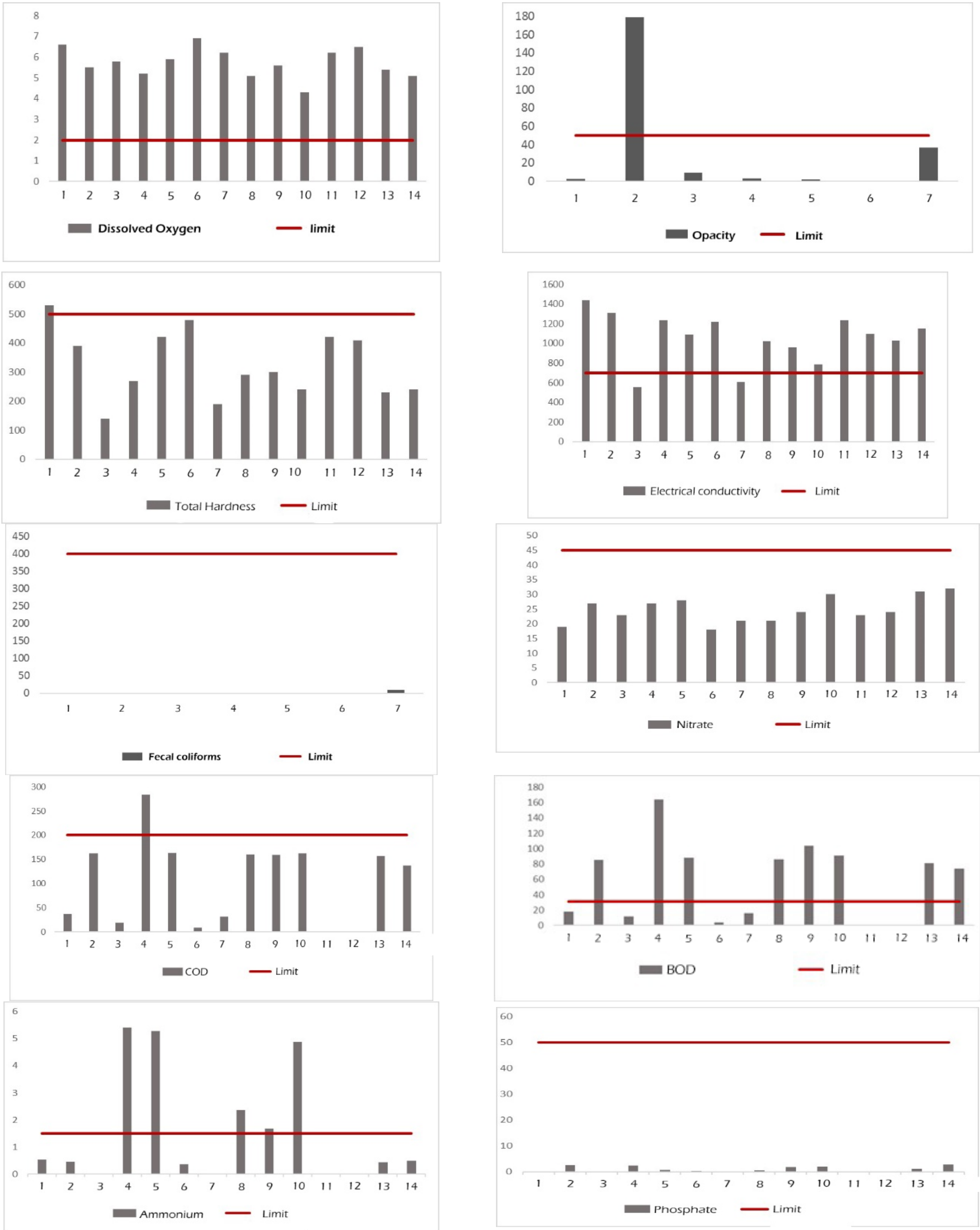

Figure 3. Comparison of measured parameters of conventional surface water contamination with standard.

Among all the samples, the best quality in terms of common parameters is the new castle channel. This could be due to the discharge of the wastewater treatment plant upstream of the canal. The discharge of the outlet of the treatment plant, which naturally qualifies, improves the pollutants in the new castle and increases its relative quality. However, with the passage of this canal from the residential areas of Gelenovo Haj Musa and the probability of illegal drainage of sewage, there is a potential for water quality reduction (Table 9) (University of Tehran, 2016).

Table 9. Contamination of surface water index for samples

Row	Sample name	Qualitative description	Surface water pollution index
1	North Shahid Kazemi	Fairly bad	30
2	Motahari	very bad	11
3	North Bahmanyar	Fairly bad	36
4	Ahmadiyeh city	very bad	9
5	Ahmadiyeh city	very bad	11
6	South Shahid Kazemi	Fairly bad	36
7	South Bahmanyar	Fairly bad	32
8	Azadegan - Shaghayegh	very bad	14
9	Azadegan	very bad	13
10	Kalhor	very bad	11
11	Ghale No- Bala dast	very bad	46
12	Ghale No- Paien dast	Fairly bad	43
13	Upper handed of Kan river	very bad	11
14	Lower handed of Kan river	very bad	10

Concerning groundwater, studies have shown that SAR parameters and electrical conductivity have the highest weight in determining the water quality index. Also, the evaluation of this indicator states that all target points are contaminated and classified in the bad and relatively poor range ... Ground water, East water reservoir points, Touba Water forests, Natural wells water reservoir, Kashaloot reservoir water and water wells of Behaesht Park were in the bad situation, Afra forest and well water and Velayat well water were relatively poor (Table 10).

Table 10. Indicator of pollution by demarcation of underground samples

Row	Sample name	Qualitative description	Groundwater pollution index
1	Eastern Water tank	Bad	28.7
2	Touba Forest water	Bad	28.7
3	Water wells of Afra Forest	Fairly bad	36.5
4	water wells of Akhlaghi tank	Bad	22.4
5	Water tank Kashalut	Bad	26.6
6	Well water of Velayat garden	Fairly bad	32.6
7	Water Wells Behesht Park	Bad	29.8

In general, the assessment of the water quality index indicated that the surface and underground water in the Tehran district 19 in the medium to very high level of contamination. According to Figure 3, except for the 11th point (Ghale No – Bala dast), its surface water index is moderate and is located on the contamination border. Other parts of the area have contaminated water to irrigate crops, especially vegetables. Hence, increasing sewage generated by industrial, commercial and residential uses, untreated wastewater for agricultural use, especially for vegetable crops, lack of alternative water resources for irrigation in the region, the supply of contaminated products to urban areas could lead to risks such as direct contamination by farmers, contamination by individuals who exposed to sewage aerosols, contamination by animals that are grazing in the field irrigated with sewage, pollution of groundwater aquifers and health of consumption.

Table 11. Calculation of the Nemerow Index and Classification of Soil Quality from Heavy Metals in the Target Points of the 19th District of Tehran Municipality

Point	Sampling site	Oral Variable Description	P_S	P_{max}	P_{ave}
1	Velayat park	Low contamination range	1.55	2.14	0.50
2	Saeidi highway	Highly infected area	3.82	5.34	0.82
3	22 Bahman Park	Low contamination range	1.47	2.04	0.45
4	Khalazil Street waste recycling	Low contamination range	1.46	2.00	0.53
5	Concrete brick factory	Fairly contaminated	2.04	2.82	0.60
6	Reconnaissance Station and Azadegan Municipal Services	Precautionary Range	0.72	0.94	0.39
7	Khalazil street- Onsory street- Mino Square Residential Project and Snowy Headquarters	Low contamination range	1.54	2.11	0.54
8	Keshavarz - South Golriz	Low contamination range	1.50	2.06	0.52
9	Worker Township Services District 5 – Afra Park	Low contamination range	1.39	1.91	0.49
10	Plaeen agricultural land	Low contamination range	1.49	2.05	0.47
11	Residential 5th District Technical and Development Workers, behind the building of the Resalat neighborhood	Low contamination range	1.66	2.28	0.57
12	Etka agricultural land, Abbas Abad castle	Low contamination range	1.46	2.01	0.47
13	Children's playground and playground, Ghale NO	Low contamination range	1.74	2.40	0.57
14	Jafarabad Agricultural land - jafarabad water engine	Low contamination range	1.47	2.01	0.55
15	Sabzikari, Ahmadiyah	Low contamination range	1.46	1.99	0.52
16	Nasim Avenue - Ahmadiyeh city	Low contamination range	1.75	2.40	0.59

According to the results, most of the target points of the 19th district of Tehran, which are representative of the soil environment of the whole region, are confined in heavy metals in the area of pollution. This range, the third stage of the five steps, increases the risk of heavy metals pollution. In other words, the status of the soil environment in Tehran is beyond the boundary of the alert and in the beginning of creating problems for the health of individuals and other organisms. Table 12- The pollution of agricultural products by heavy metals in district 19 of Tehran

Table 12. Plant sampling points (ppm)

Sample	Point	Mercury		Cadmium		Lead		Sample type
		Limit	Measured	Limit	Measured	Limit	Measured	
1	District3	-	NA	0.1	0.8	0.2	14.5	Basil
2	Ahmadiyeh city	-	NA	0.1	0.24	0.2	11.06	Leek and parsley
3	Saleh Abad	-	NA	0.05	0.3	0.1	11.9	Radish
4	Azadegan around	-	NA	0.1	0.53	0.2	12.98	Mint

According to table 12, the amount of lead and cadmium measured in the studied area is much higher than the permissible limit of the Institute of Standards and Industrial Research of Iran, and only the mercury parameter was not available in the measurement samples because of the contamination of vegetables grown in the region due to the use of contaminated wastewater. Also, the results showed that lead and cadmium concentrations were different in the studied vegetables, indicating a difference in the accumulation of lead and cadmium in these vegetable species. The highest amount of lead and cadmium measured is basil and mint (samples 1 and 4) and the lowest is in turkeys and parsley (sample 2).

Nexus Water Analysis - Agriculture - Pollution and Health

In this section, the 5-component Nexus intermediators and stability indicators are compared to the optimal situation. Table 13 shows the results.

After evaluating the 5 main interveners, the significance of each of the components in the challenges presented in the study area with the radar chart is shown in Figure 24-28. The purpose of this chart is to identify the most stressful components and provide strategies for managing them at all levels and sectors. Based on this diagram which has been taken form quantitative and qualitative analyzes sewage use in the study area, the highest pressure is due to the presence of pollution in the region in the first stage on agricultural products and, in the next step, on the health of the community and the environment of that area.

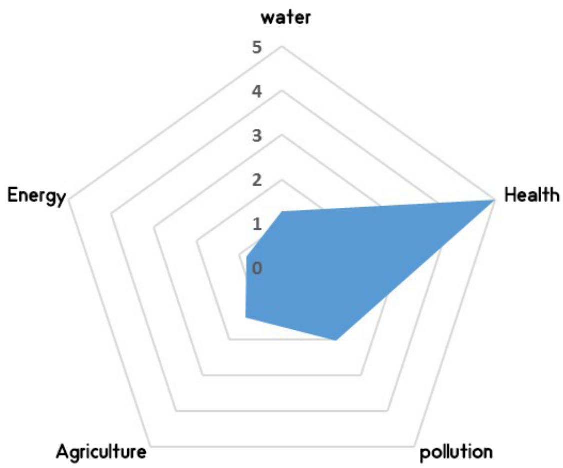

Figure 4. Importance of Nexus main components

Conclusion

With increasing demand and shortage of water resources in the 19th District of Tehran Municipality, the trend of sewage and wastewater usage has been increasing in recent years. This has encountered major challenges to the relationship among the three main water, agriculture and pollution and sanitation areas. The use of contaminated surface and subsoil waters and the desire to reduce energy consumption has led to soil contamination and subsequent agricultural production, reducing the population and ecosystem resilience of the study area against pre-prepared crises and has put human and environmental health in serious danger. Healthy soil and water is one of the most important factors in the cultivation of crops (vegetables) due to the lack of unbalanced distribution. In recent years, due to the challenges that have been made, farmers have used more water in order to achieve greater profitability in the short term, and the lack of attention to the irrigation of products with clean water or treated wastewater has led to pressure towards the ecosystem of the region and has increased the vulnerability of the community and the environment. Therefore, implementation of an environmental management program in the region is necessary (Padash and Ataee, 2019).

Table 13. Measurement the importance of each Nexus component

Final value	Reference weight	Weight	D			R	c	Indicator	Group
			%	x/r	X				
1.27	1.66	2	-68	0.68-	-36540000	54090000	17550000	Total water used for vegetable and vegetable production in area 19 (product in water used for seafood) (cubic meters)	Water
	1.02	3	-98	-0.98	-295.4	300	4.6	Total refined water (million cubic meters)	
0.83	1.66	1	-68	-0.68	-1877000	2754500	877500	Total energy for irrigated lands	Energy
1.4	1.4	3	-67	-0.67	-67	100	33	Percentage of irrigated land with wastewater / crop	Agriculture
2.05	2.06	3	-7	-0.07	-7	100	93	Percentage of polluted areas by wastewater pollutants / area	Contamination
	2.04	3	-6	-0.06	-6	100	94	Percentage of polluted areas by contaminated soils	
5	5	3	570	5.7	57	10	67	Percentage of risk for water used for products	Health
	5	3	800	8.0	80	10	90	Percentage of risk in terms of total pollutants	

Table 14. Environmental Management Plan (EMP) for safe use of wastewater for irrigation of south of Tehran

-Identification of the agricultural area on the map - Cultivation type, area, water requirement	Set the range	planning
-Study of water resources and water supply routes to agricultural land, -Determine the combined routes of water and wastewater -Use the area capacity to set up existing refineries in the area or build new refineries.	Determine water resources	
- Study of water resources and water supply routes to agricultural land, - Determine the combined routes of water and wastewater -Use the area capacity to set up existing refineries in the area or build new refineries.	Regular measure	
- Wetland	Water treatment in the short term	Implementation and monitoring
- Product Selection (cultivation of products that do not treat wastewater with fruit and vegetables like wheat) - Selecting the irrigation method - Reducing the risk of pollution, such as improving water quality - Managing contact with contaminated water - Management of waste water at farm level -Product control before and after harvest	Irrigation management with wastewater	
Increasing environmental knowledge at various levels of society, especially farmers, authorities and decision makers.	Education and awareness	
- Using effective levers and increasing the executive power of laws and regulations to comply with national standards and directives. - Participation of local and state institutions	Institutional	
- Signaling the alarm system in the area -Installation of warning boards in areas where the water quality index is placed in a bad grouping.	Quick alert	Monitoring
- Review the progress and actions required for changes.	Corrective actions	review

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