WATER QUALITY AND RESIDUALS OF NITRATE - NITRITE IN SOME VEGETABLE PLANTED IN CEMETERY AT THANH TRI DISTRICT, HANOI, VIETNAM

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SUMMARY

Vinh Quynh commune, Thanh Tri district, Hanoi is well-known for one of the places that provides a lot of vegetables for Hanoi people, but the vegetables growing near the cemetery area contain numerous of hidden risks. To assess water quality and the residuals of nitrate and nitrite contents in three types of vegetables: *Ipomoea aquatic, Nasturtium officinale*, and *Oenanthe javanica*, the study took 12 surface water samples to analyze pH, TSS, COD, NO_2^-, Fe, NH_4^+, PO_4^{3-} and NO_3^- and 10 groundwater samples for analyzing pH, Fe, NO_2^-, PO_4^{3-} and NO_3^-. In addition, 16 vegetable samples (10 samples of water spinach, 3 samples of watercress, and 3 samples of water dropwort) were collected to analyze nitrate and nitrite concentration in vegetables by a method of extraction and chemical color. The main results of the study included: (1) The surface water was polluted in Fe, PO_4^{3-}, NO_2^-, NH_4^+, COD, TSS and NO_3^- whereas groundwater was polluted in 4 indicators: Fe, PO_4^{3-}, NO_2^-, and NO_3^-. Especially, NO_3^- and PO_4^{3-} had the highest concentration which exceeded 18 times permitted level for surface water sample nearest distance to the cemetery. The WQI index of groundwater was very poor at 208.5. Pollution of groundwater may be due to the infiltration of pollution sources from surface water. Typically, the correlation index of NO^{3-} concentration in surface water and fresh water is very high (r = 0.972); (2) All types of vegetables had NO_3^- concentration exceeded the permitted levels of WHO and EC. Vegetable sample located nearest the cemetery had the highest NO_3^- contents were 742 and 728 mg/fresh-kg, surpassed 2.5 times the safe level, respectively.

Keywords: Cemetery, groundwater quality, residuals of nitrate – nitrite in vegetable, surface water quality, Vinh Quynh commune.

1. INTRODUCTION

Cemeteries has been consider as one of the possible environmental contamination sources (Jonker and Olivier, 2012). Previous researches pointed out that pollution caused by cemeteries was derived from the minerals which were released by burial loads (Osabuohien et al., 2000). If inappropriately located or insufficiently protected, cemeteries pose a significant health problem for people (Fisher and Croukamp, 1993). The pollutant may leach out from the grave and diffuse into the water and soil, and it may cause the health risk to the nearby community.

Burial have significant impact on water chemistry in both short term and long term (Zychowski, 2012). The substance leached out from the grave cause the increase concentration of chemical element (Żychowski et al., 2006), ptomaine, amino acid and other organic compounds (Żychowski et al., 2002; Żychowski, 2007). Especially, the shallow groundwater is vulnerable to the contamination of the burial site, because it has high permeability, and low capacity to withhold pollutant (Zychowski, 2014). A study which was conducted in Portugal in 2003 pointed out that, water at the place nearby the cemetery had higher levels of bacteriological contamination that one at the place about 300 meter far away (Zychowski, 2014).

Due to the negative impact of cemeteries on the water and soil, the negative influence on the quality of vegetable at this site is unavoidable. The root system of plant absorb water from the soil beneath, so when the soil and water are polluted, laterally it will lead to the plant contamination (Akan et al., 2013). The amount of bioaccumulation in a single plant will increase with the time if chemical residual is persistent (Akan et al., 2013). Among types of pollutant which are derived from burial area, Nitrat and Nitrit residual in vegetable are strongly concerned, especially in term of human health effects (Nhu et al., 2016) as the main source of Nitrat and Nitrit absorbed in human body is through vegetable (Menard et al., 2008). These substances can cause Methaemoglobi-naemia, stomach cancer, thyroid cancer and other types of mutation (Mikuska et al., 2003; Nhu et al., 2016).

In Vietnam, for a thousand years, interment has long been the main funeral practices, as it is the whole nation's culture and custom. This activities has the potential to cause the low quality of water and vegetable (Oliveira et al., 2012). Behind, due to the lack of knowledge and inappropriate management, most of the burial sites are located nearby the water source, the crop filed and the residential area. This fact makes the pollution issue become more serious. Furthermore, in our country, the contamination impact of cemetery were not sufficiently taken into account. Thus there are still remain unresolved questions with respect to this issue. This study was conducted with the main goal is to assess water quality and Nitrat and Nitrit residual in Ipomoea aquatic from cemetery in Thanh Tri, Hanoi, Vietnam.

2. RESEARCH METHODOLOGY

2.1. Study site

Vinh Quynh is a suburban commune in the southwest of Thanh Tri district (13 km far from Hanoi center) located in the central urban development area of Hanoi (Fig. 1). The commune has a low-lying terrain along the dyke edge of the Red River Delta and has an average altitude of 4.2 - 4.5 m. The average temperature is 23.9^{o}C, while the average humidity and average annual precipitation is 78% and 1800 mm, respectively. In the district, there are numerous big rivers flowing through, such as Red River, Nhue River, To Lich River, Ngu River, Set River, Kim Nguu River... Besides, there is also a large area of lake like Yen So, Linh Dam, Dinh Cong and Phap Van. The commune has 25,012 people, equivalent to 6,865 households, distributed in 14 residential clusters. The majority of citizens have used surface and ground water for living and production activities.

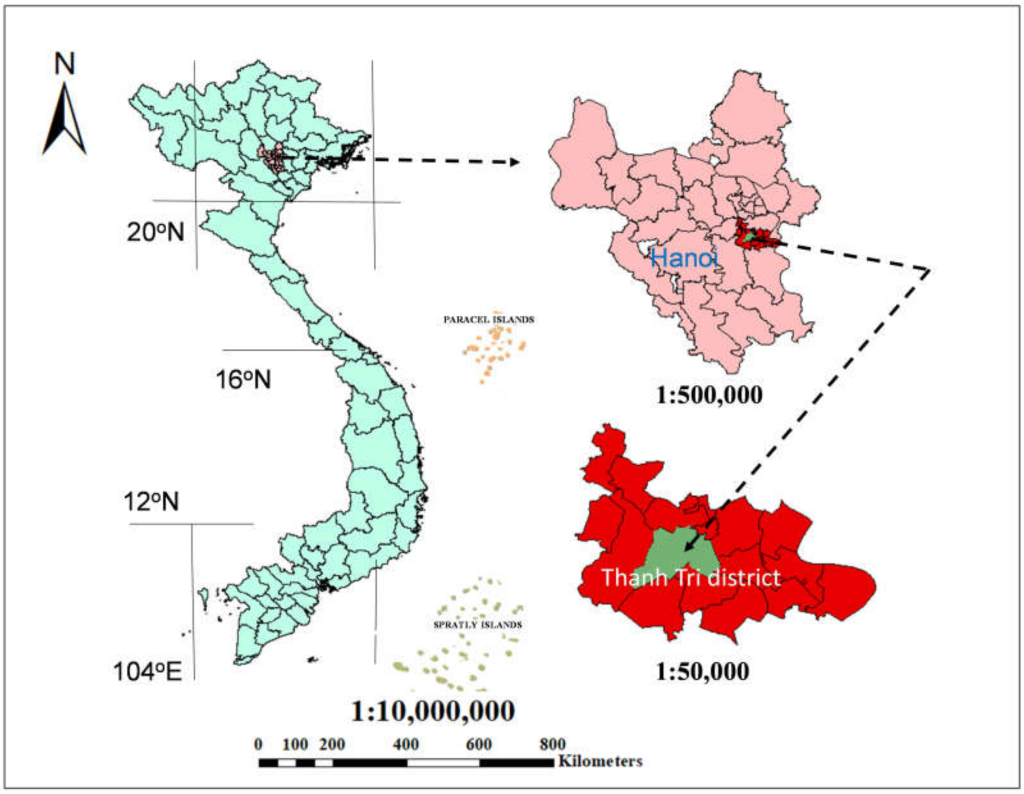

Figure 1. Location of study site

2.2. Methods

2.2.1. Evaluate water quality at the study site

Figure 2. Locations of water and vegetable samples

12 samples of surface water and 5 samples of ground water were selected around the cemetery of Thong pagoda - Quynh Do village to analyse on 13th March 2019. In particular, sample S4, S7 and S9 are located in the cemetery, however sample S6 is furthest from the cemetery about 220 m (Fig. 2).

17 samples of water were taken according to the sampling principle of the Ministry of Natural Resources and Environment: Taking samples by prepared plastic bottles and washing with water at least 3 times to ensure that no external impurities in the sample, then carrying out sampling. Samples were transported to the laboratory in the shortest time and were kept in a dark place and stored at 2 - 5°C by ice to avoid contamination and discoloration. Chemicals used for preservation should be pure to minimize errors in analysis. Surface water was analyzed for 7 indicators including: pH, Fe, PO_4^{3-}, NO_2^-, NH_4^+, COD, TSS, and NO_3^- whereas groundwater only analyzes 4 indicators: pH, Fe, NO_2^-, PO_4^{3-} and NO_3^- according to the methods in table 1.

Table 1. Methods to analyze water quality in laboratory

Indicators	Methods	
	Surface water	Groundwater
pH	TCVN 6492:2011 (ISO 10523:2008)	TCVN 6492:2011 (ISO 10523:2008)
Fe	TCVN 6177:1996 (ISO 6332:1988)	TCVN 6177:1996 (ISO 6332:1988)
PO_4^{3-}	TCVN 6494-1:2011 (ISO 10304-1:2007)	TCVN 6494-1:2011
NO_2^-	TCVN 6494:1999	TCVN 6178:1996 (ISO 6777:1984)
NH_4^+	TCVN 6179-1:1996 (ISO 7150-1:1984)	TCVN 5988:1995 (ISO 5664:1984)
COD	TCVN 6491:1999 (ISO 6060:1989)	-
TSS	TCVN 6625:2000 (ISO 11923:1997)	-
NO_3^-	TCVN 6180:1996 (ISO 7890-3:1988)	TCVN 7323-1:2004 (ISO 7890-1:1986)

The results analyzed from laboratory then would be compared with the Vietnam standard of Ministry of Natural Resources and Environment: QCVN 08:2015/BTNMT for surface water quality; QCVN 09:2015/BTNMT, and standards about domestic water of Ministry of Public Health: QCVN 01:2009/BYT, QCVN 02:2009/BYT for groundwater quality.

The statistics of surface water and groundwater are analyzed, described and correlated by SPSS software. The matrix of r correlation index between criteria is established. If the index r > 0.8, the indicators are strongly correlated with each other. It is called correlation coefficient of physicochemical.

The results of sample analysis were interpolated by IDW method (1) for the whole area on Arcmap software. The formula is:

$$Z(S_o) = \frac{\sum_{i=0}^{n} Z(Si)\,\lambda i}{\sum_{i=1}^{n}(\lambda i)} \qquad (1)$$

Whereas: $Z(S_o)$ is the value of the i^{th} point; S_o is the position to be interpolated; n is the number of known points within a certain distance from the position to be interpolated.

λi is the weight of i^{th} point: $\lambda i = 1/d_i^p$ (d_i is the distance between point i and So, P is the exponent of the distance).

Particularly for groundwater, from the criteria, the study conducted to calculate the water quality index of WQI by the formula (2-5) (Vasanthavigar et. al, 2010):

$$Wi = \frac{wi}{\sum wi} \qquad (2)$$

Whereas: wi: weight of each parameters: w(pH) = 4; w(Fe)= 5; w(NO_2^-) = 5; w(NO_3^-) = 5; w(NH_4^+) = 5; w(NO_3^-) = 5; w(PO_4^{3-}) = 1

Wi: relative weight values

$$WQI = \sum_{i=1}^{n} SIi \qquad (3)$$

$$SI = Wi\ x\ qi \qquad (4)$$

$$qi = \frac{Ci}{Si}\ x\ 100 \qquad (5)$$

Whereas: WQI: Water quality index; qi: the quality rating; Ci: Concentration of indicator; Si: Permitted level of TCVN 09:2015/BTNMT.

After calculate WQI of groundwater, it was compared with the standard to conclude the current status in table 2.

Table 2. Status of Water Quality based on WQI (Vasanthavigar et. al, 2010)

WQI range	Status
< 50	Excellent
50 – 100	Good
100 – 200	Poor
200– 300	Very Poor
> 300	Unfit For Drinking

2.2.2. Evaluate the residual of nitrate and nitrit contents in some vegetable

16 vegetable samples include 10 samples of *Ipomoea aquatic*, 3 samples of *Nasturtium officinale* and 3 samples of *Oenanthe javanica* were collected at different locations (Fig. 2). Each sample of vegetables was taken at an adult stage. The samples are stored in plastic bags with the necessary information and transferred to the laboratory for analysing the residuals of nitrate and nitrite. The results would be compared with the standards of WHO and EC.

3. RESULTS AND DISCUSSION

3.1. Water quality in the cemetery at Vinh Quynh commune

3.1.1. Surface water quality in the cemetery

In general, the contents of substances in surface water were relatively high with 6/7 criterias (except pH) exceeding the permitted level according to TCVN 08: 2015/TNMT including: pH, PO_4^{3-}, NO_2^-, NH_4^+, COD, TSS and NO_3^- (Table 3) and difference at different location. PO_4^{3-} had the greatest difference between the maximum and minimum value, was 58 times (Table 3). 9/12 samples had PO_4^{3-} content exceeding the limit. Because of the location near the grave, samples 4 and 9 had the highest phosphate content were 5.8 mg/l and 5.5 mg/l exceeded 19 and 18 times the permitted level, respectively (Fig. 3b). There are 5 out of 12 ion samples exceeding the standard, especially at sample 5, the iron content is 5.2 mg/l, 3.5 times higher than the norm (Fig. 3a). 100% of samples have concentrations of NO_2^-, NH_4^+, COD and TSS exceeding the permitted level. Sample 8 was the highest nitrite polluted area with the concentration was 0.9 mg/l exceeding 18 times the norm (Fig. 3 and Table 3).

Table 3. Surface water quality at the study site

No.	Samples	pH	Fe (mg/l)	PO_4^{3-} (mg/l)	NO_2^- (mg/l)	NH_4^+ (mg/l)	COD (mg/l)	TSS (mg/l)	NO_3^- (mg/l)
1	S1	7	2.2	0.1	0.4	2.7	528	383	36.70
2	S2	7.2	0.9	0.1	0.2	3.1	96	138	34.54
3	S3	7.6	1.5	0.7	0.5	4.4	48	204	30.77
4	S4	7.7	0.4	5.8	0.2	1.8	192	347	18.53
5	S5	7.3	5.2	2.9	0.2	2.9	96	157	27.97
6	S6	8.0	0.5	0.6	0.1	4.9	144	50	32.21
7	S7	7.8	3.7	3.0	0.2	8.4	48	54	22.12
8	S8	6.1	1.2	0.5	0.9	4.8	144	219	32.44
9	S9	5.8	2.1	5.5	0.1	4.3	192	206	28.40
10	S10	7.3	0.8	2.5	0.2	4.6	48	163	25.76
11	S11	5.9	0.4	3.0	0.2	4.8	96	110	-
12	S12	7.6	2.3	0.1	0.5	4.9	192	180	-
Max.		8.0	5.2	5.8	0.9	8.4	528.0	383.0	36.7
Min.		5.8	0.4	0.1	0.1	1.8	48.0	50.0	18.5
Mean		7.0	1.62	2.07	0.31	4.3	152.0	184.3	28.9
Median		7.2	1.05	1.6	0.2	4.5	120.0	171.5	29.6
Std.		0.79	1.49	2.05	0.23	1.65	130.78	100.87	5.52
QCVN 08:2015/ BTNMT (B1)		**5.5 - 8**	**1.5**	**0.3**	**0.05**	**0.9**	**30**	**50**	**10**

Surface water quality was different at at different sampling locations may be due to the fact that on all ponds, canals and fields near these graveyards, received different untreated sources of waste, or the closer the site to the cemetery area, the poorer the water quality.

In addition, the correlation among the indicators was greater than 0. The surface water index had almost no significant correlation. However, the index between NO_3^- and PO_4^{3-} was the largest correlation, r reaches 0.813 (Table 4). This suggests that there are close relationship between NO_3^- and PO_4^{3-} of surface water.

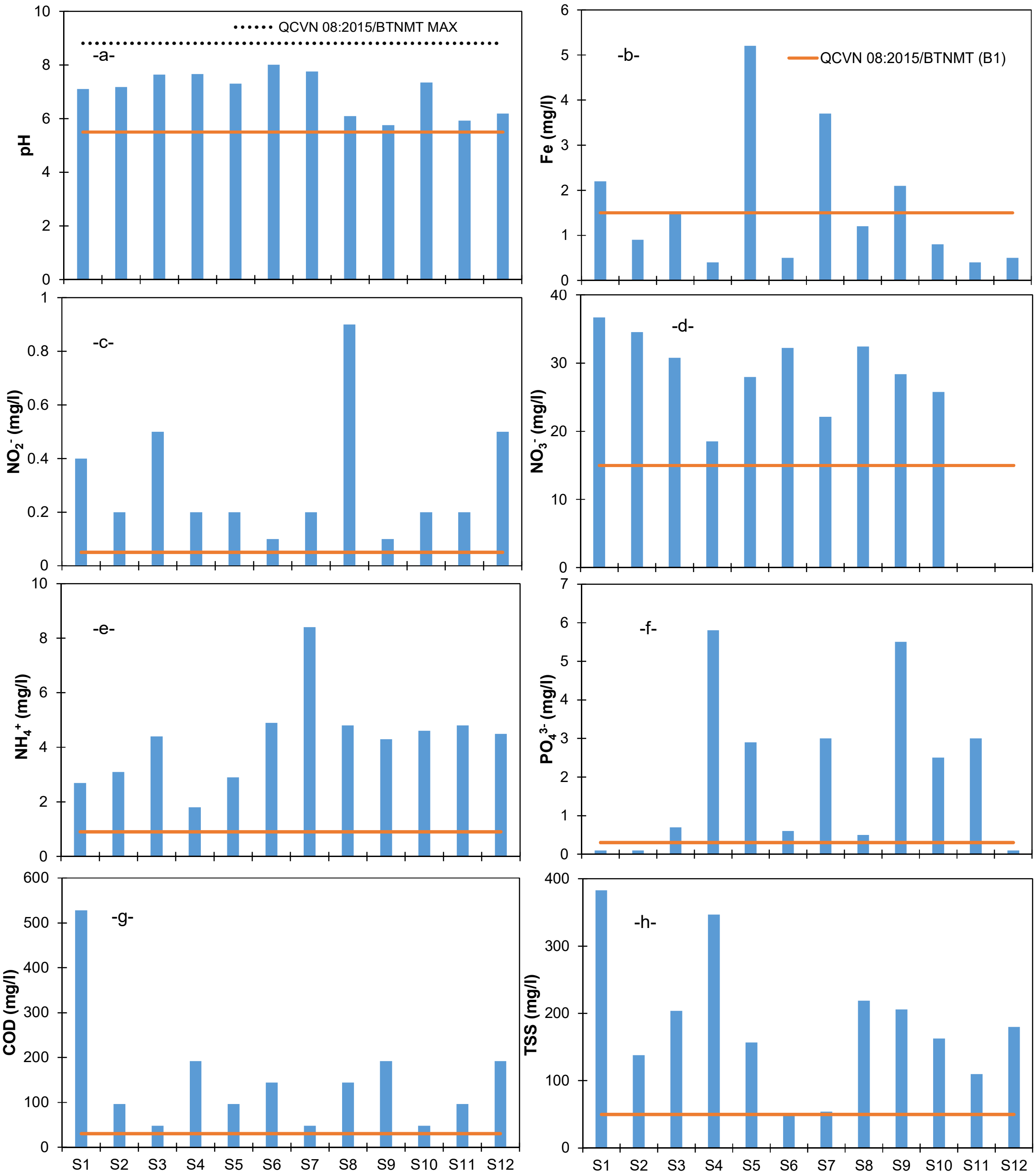

Figure 3. Surface water quality: a - Fe concentration; b- pH; c - NO_2^- concentration; D - NO_3^- concentraiton; e - NH_4^+ concentration; f - PO_4^{3-} concentration; g - Chemical oxygen demand (COD); h- Total suspended solid (TSS)

Table 4. Correlation coefficient matrix of physicochemical parameters of groundwater

Variable	pH	Fe	PO_4^{3-}	NO_2^-	NH_4^+	COD	TSS	NO_3^-
pH	1	0.178	0.086	0.319	0.021	0.146	0.107	0.266
Fe		1	0.162	0.127	0.167	0.025	0.098	0.096
PO_4^{3-}			1	0.514	0.074	0.168	0.124	**0.813**
NO_2^-				1	0.025	0.142	0.311	0.345
NH_4^+					1	0.443	0.693	0.183
COD						1	0.772	0.418
TSS							1	0.051
NO_3^-								1

*Note: **bold** = strong correlation ($r > 0.8$).*

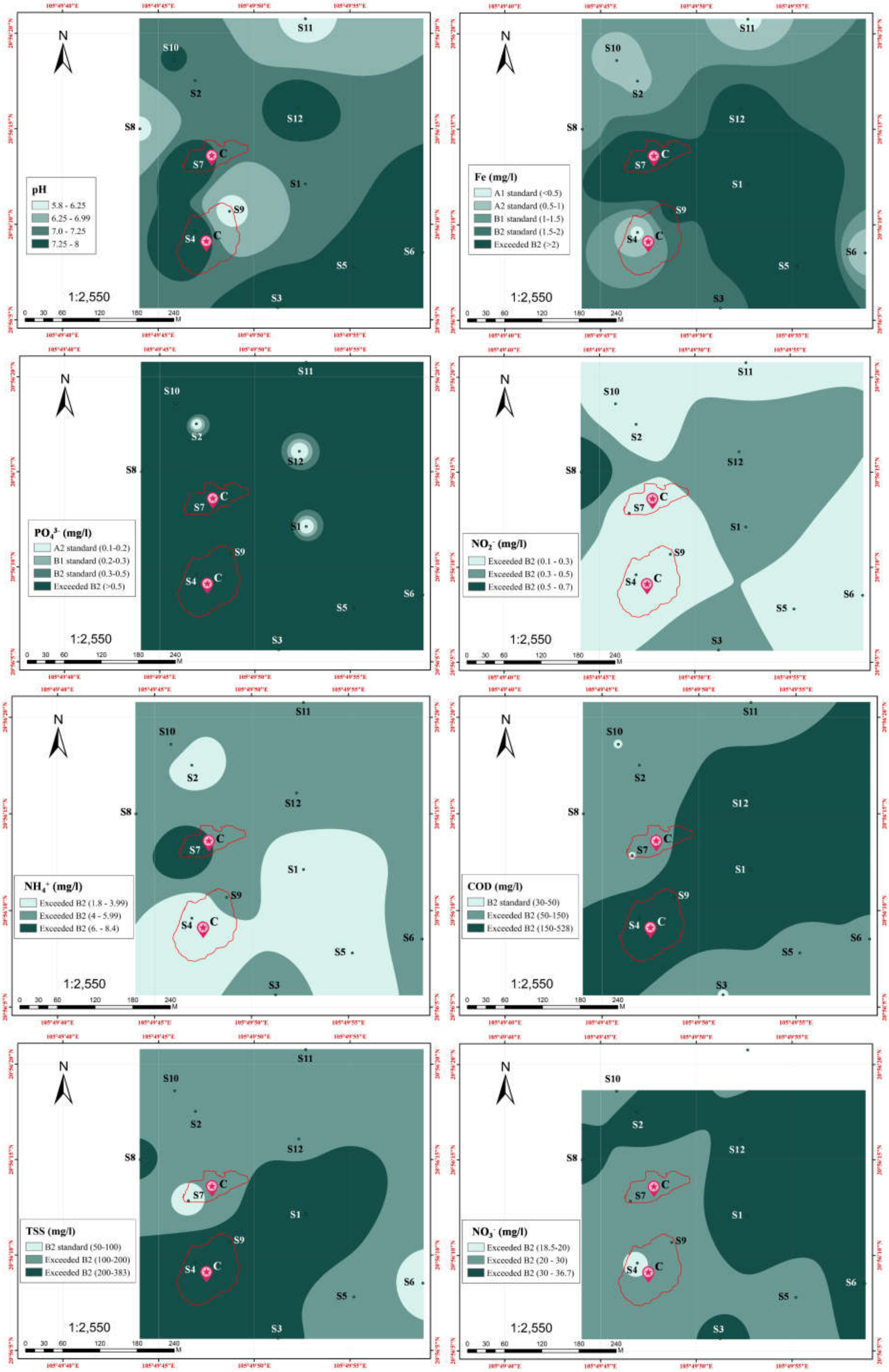

Figure 4. Interpolation map of surface water quality

The spatial distribution maps of pollution showed the concentration of TSS, COD, Fe concentrated in the northwest area, while NO_2^-, NH_4^+, PO_4^{3-} more distributed in the southwest (Fig. 4). On the other hand, the spatial distribution of the criteria was heavily polluted in areas near the cemetery. Although the water in the area was mostly contaminated with B2 level, which was not suitable for irrigation and farming, however, due to the lack of clean water, the farmers continued to use. In general, the closer to the cemetery area, the darker the color, the lower the water quality.

3.1.2. Groundwater quality in the cemetery

The quality of groundwater varies among the points and polluted with 4/5 of the indicators have exceeded the threshold according to QCVN 09: 2015/TNMT, QCVN 01:2009/BYT and QCVN 02:2009/BYT including Fe, NO_2^-, NH_4^+, and PO_4^{3-} (Fig. 5 and Table 5).

Table 5. Groundwater quality at the study site

Samples	pH	Fe (mg/l)	NO_2^- (mg/l)	NH_4^+ (mg/l)	PO_4^{3-} (mg/l)	NO3- (mg/l)
G1	6.18	5.12	0.80	4.50	4.60	44.68
G2	6.22	4.00	1.02	4.00	5.12	45.97
G3	6.36	5.02	1.00	3.60	4.00	42.09
G4	6.12	3.23	2.34	4.02	4.34	20.81
G5	7.00	3.00	4.56	5.36	4.32	37.43
Max.	7.00	5.12	4.56	45.97	5.36	5.12
Min.	6.12	3.00	0.80	20.81	3.60	4.00
Mean	6.38	4.07	1.94	38.20	4.30	4.48
Median	6.22	4.00	1.02	42.09	4.02	4.34
Std.	0.36	0.98	1.59	10.25	0.67	0.42
QCVN 09:2015/TNMT	**5.5 - 8.5**	**5**	**1**	**1**	**4**	**15**
QCVN 01:2009/BYT	**6.5 - 8.5**	**0.3**	**3**	**3**	**-**	**-**
QCVN 02:2009/BYT	**6.0 - 8.5**	**0.5**	**-**	**3**	**-**	**-**

pH of groundwater was within the permitted threshold under QCVN 09 of MONRE (Table 5). Iron concentrations of 5 samples were seriously polluted, which exceed the standard of MONRE and the Ministry of Health (MOH). Samples 1 and 3 have the highest iron concentrations at 5.12 and 5 mg/l, respectively (Fig. 5b). Concentrations of NO_2^- of samples 1, 2, 3, and 4 are within the safety level according to the standards of the MOH. However, considering the regulations of MONRE for groundwater, all 5 samples exceed the standard from 1 to 4.5 times. According to the results of ammonium analysis, all 5 samples of groundwater had concentrations exceeding the permitted level according to the regulations of both the MOH and the MONRE. The highest NH_4^+ concentration was 5.36 mg/l at sample 5 due to the sampling location near the field, effected by a large amount of pesticides and chemical fertilizers. PO_4^{3-} concentration was only compared to groundwater standards of MONRE. All 5 water samples have concentrations greater than the permitted level from 1 to 1.3 times (Fig. 5f). NO_3^- concentration witnessed the overtaking at all point, ranged points from 1.3 to 3.6 times. The place with the highest concentration of PO_4^{3-} is location 2 which was nearest the cemetery area (Table 5).

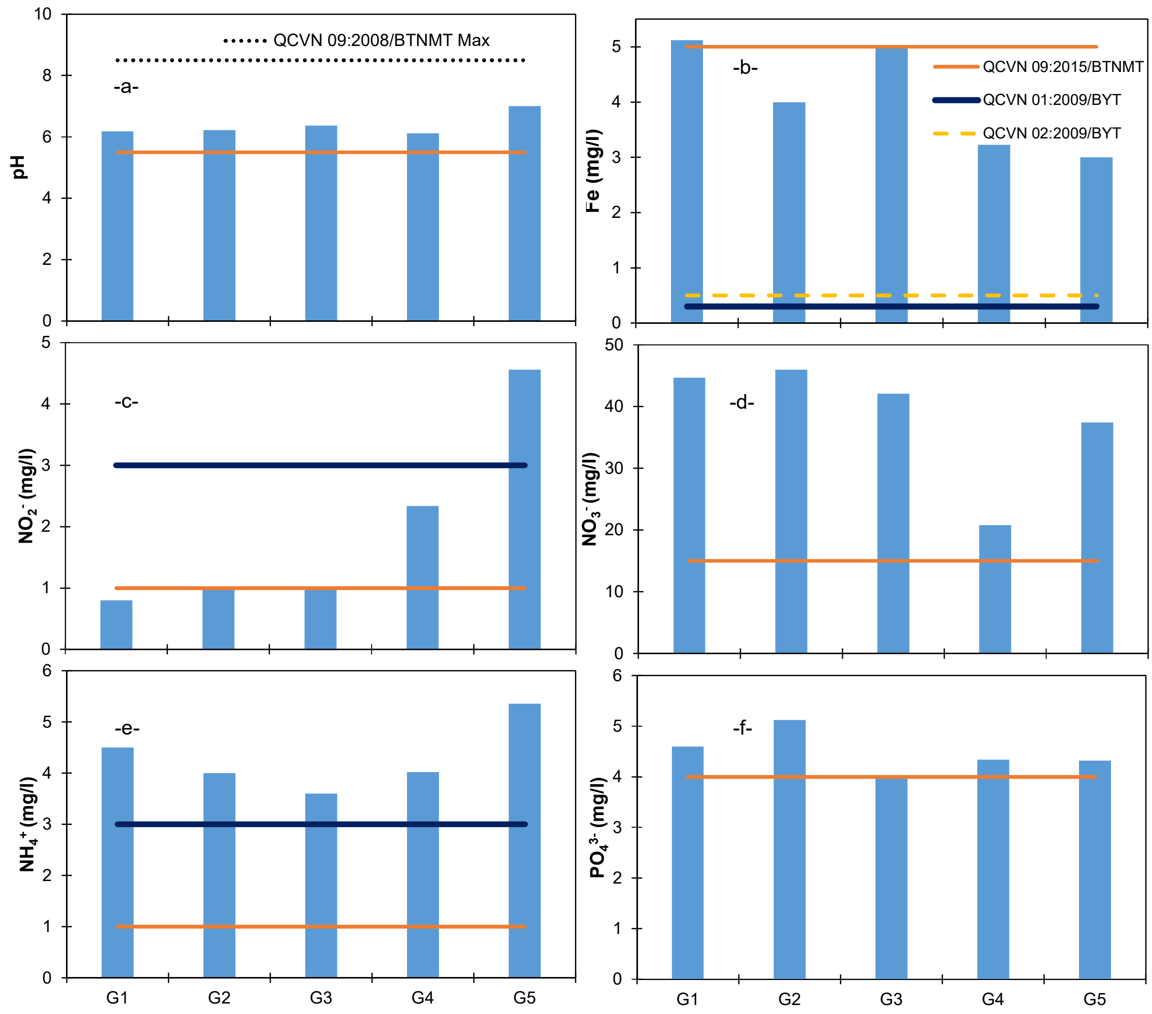

Figure 5. Groundwater quality: a - pH; b - Fe concentration; c - NO_2^- concentration; D - NO_3^- concentration; e - NH_4^+ concentration; f - PO_4^{3-} concentration

For estimation of groundwater quality index (WQI), the weight for each indicators ranged from 1 to 5 depend on the risk of them to human health. There were 4 indicators: Fe, NO_2^-, NO_3^-, NH_4^+ weighted 5, having the worst effect to our health. Moreover, 4 of them also exceeded the permitted level of TCVN 09: 2015/BTNMT (Tables 2 and 6). Final result of WQI in groundwater in Vinh Quynh were 208.5, comparing to the classification, it was "very poor" quality.

Table 6. WQI of groundwater at the study site

Locations	SI						WQI = $\sum SI$
	pH	Fe	NO_2^-	NO_3^-	NH_4^+	PO_4^{3-}	
1	11.63	20.48	16.0	59.57	90.0	4.60	202.29
2	11.71	16.00	20.4	61.29	80.0	5.12	194.52
3	11.97	20.08	20.0	56.12	72.0	4.00	184.17
4	11.52	12.92	46.8	27.75	80.4	4.34	183.73
5	13.18	12.00	91.2	49.91	107.2	4.32	277.80
MEAN	12.00	16.28	38.8	51.00	86.0	4.48	**208.50**

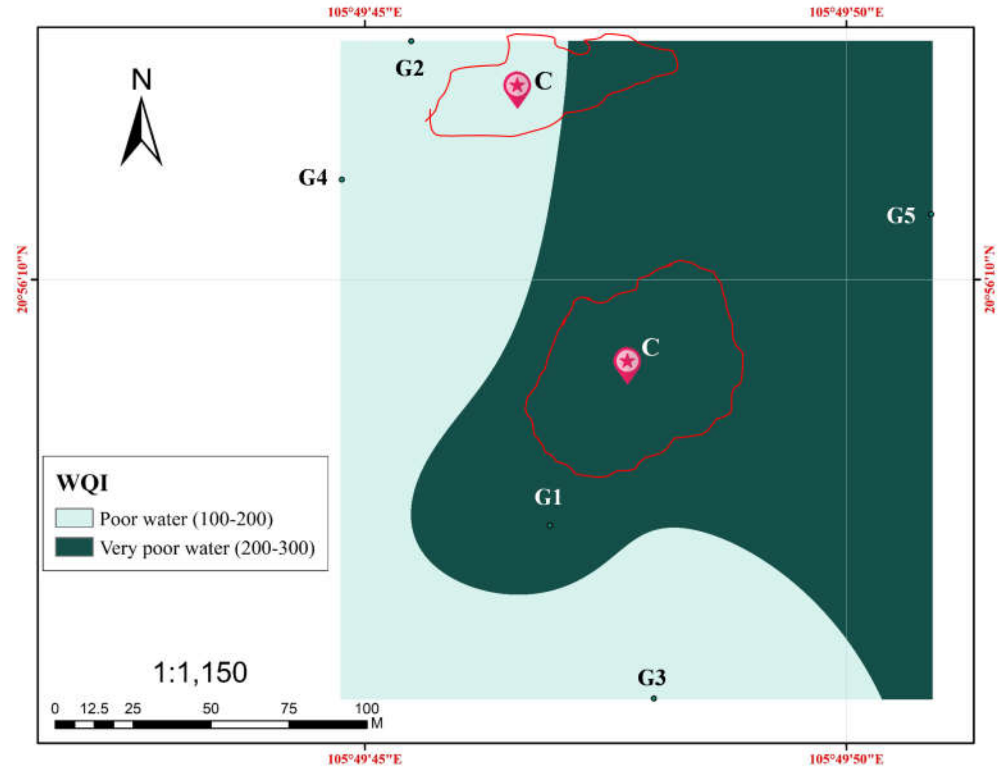

Figure 6. WQI interpolation map of groundwater at the cemetery area

From the WQI interpolation map of groundwater, we see that most of the underground water in the cemetery area of Vinh Quynh commune were in the "Very poor" category with a WQI index ranged from 200 to 277.8. Therefore, the groundwater in this area is not suitable for drinking and domestic water demand because they will bring many potential dangers. However, because of no treatment and measures to replace groundwater in domestic activities, local people still have to use polluted groundwater for daily life. Otherwise, most of the areas near the cemetery have low water quality, high WQI index is in the "Very Poor" threshold. The area of polluted water accounts for two thirds of the total interpolated area.

Table 7. Correlation coefficient matrix of physicochemical parameters of groundwater

Variable	pH	Fe	NO_2^-	NO_3^-	NH_4^+	PO_4^{3-}	WQI
pH	1	0.469	**0.839**	0.097	0.774	0.299	**0.939**
Fe		1	**0.829**	0.630	0.503	0.052	0.528
NO_2^-			1	0.418	0.788	0.283	**0.856**
NO_3^-				1	0.011	0.376	0.083
NH_4^+					1	0.033	**0.941**
PO_4^{3-}						1	0.085
WQI							1

*Note: **bold** = strong correlation (r > 0.8).*

In addition, the correlation among the indicators was greater than 0. The surface water index had almost significant correlation. The index among WQI and NH_4^+, pH and NO_2^- was the largest with r reaches 0.941, 0.939 and 0.856, respectively. Therefore, NH_4^+, pH and NO_2^- were the main causes contributed to the WQI index. Besides, the correlation of NO_3^- with pH and Fe also high, were 0.839 and 0.829, respectively (Table 7).

3.1.3. The correlation between surface water and groundwater quality

Analysis of correlation of surface water and groundwater indicators shows that NO_3^- is the most correlated with r is 0.972. Therefore, NO_3^- pollution from groundwater to groundwater makes it also polluted. WQI of groundwater has the most correlation with Fe of surface water with r = 0.963 (Table 8). In general, the cause of polluted groundwater may come from surface water.

Table 8. Correlation among the indicators of surface and ground water

Surface	Groundwater						
	pH	**Fe**	**NO_2^-**	**NO_3^-**	**NH_4^+**	**PO_4^{3-}**	**WQI**
pH	*0.100*	0.177	0.103	0.674	0.478	0.728	0.341
Fe	**0.936**	*0.305*	0.751	0.209	**0.894**	0.230	**0.963**
NO_2^-	0.216	**0.887**	*0.571*	0.425	0.440	0.499	0.382
NO_3^-	0.036	0.691	0.499	***0.972***	0.026	0.444	0.018
NH_4^+	0.197	0.577	0.304	0.657	*0.332*	0.294	0.073
PO_4^{3-}	0.079	0.751	0.579	**0.982**	0.149	*0.365*	0.099

*Note: **Bold** = strong correlation (r > 0.8); Italics = correlation of same indicator*

3.2. Residual of NO_3^- and NO_2^- in ipomoea aquatic vegetable

When analyzing nitrit content in vegetable samples, all 16 samples did not react to the chemical and did not show color, so these vegetable did not contain NO_2^-. However all of them contain NO_3^- content and had nitrate concentration exceeding the permitted level of WHO and EC standards. Sample of water spinach with the highest NO_3^- concentration was M8 at 746.8 mg/kg-fresh, 2.48 times higher than the permitted standard. Sample of watercress M1 and water dropwort M1 have the highest nitrate content of 728.3 mg/ fresh kg and 736.5 mg/fresh kg 2.43 and 2.46 times higher than the standard, respectively (Fig. 7). Therefore, it can be concluded that vegetable samples in Vinh Quynh commune, Thanh Tri district, Hanoi are contaminated with nitrate.

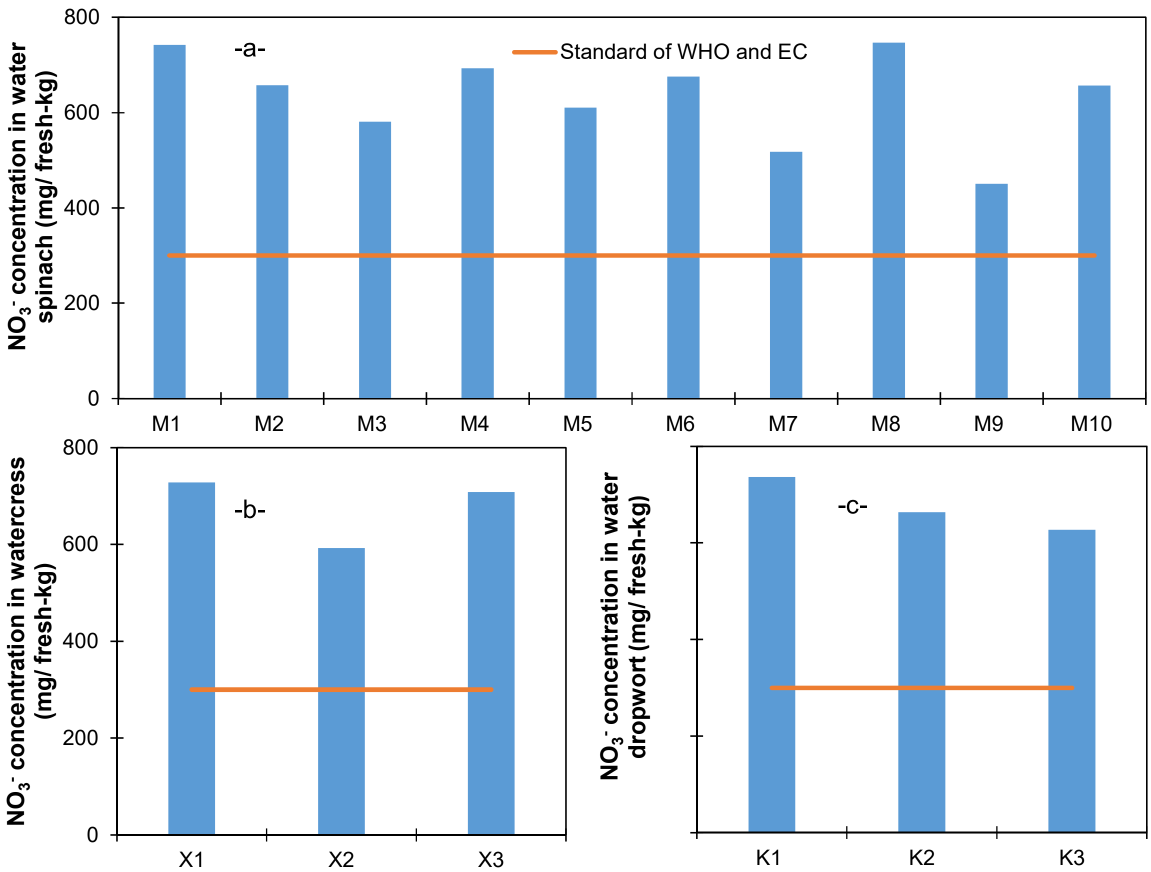

Figure 7. Residual of a - NO_3^- concentration in water spinach; b - NO_3^- concentration in watercress; C - NO_3^- concentration in water dropwort

The cause of concentration of NO_3^- in all vegetable might be come from surface water. The reason was the nitrate concentration of surface water in this area were also high and exceeded the permitted level. The vegetable usually absorb nutrient and water from surface. That was easy to uptake nitrate from irrigation which was surface water.

4. CONCLUSION

Through the study, the results are as follows: surface water quality in the study area was polluted. The parameters of surface water had only pH was within the permitted standard, while most of the remaining indicators such as TSS, COD, Fe, NO_2^-, NH_4^+, PO_4^{3-} and NO_3^- were in excess of the allowed standard. Particularly, the concentration of nitrite and phosphate exceeds 18 times the standard. Most groundwater indicators such as Fe, NO_2^-, NH_4^+, PO_4^{3-} and NO_3^- exceed the permitted levels. The highest results were NH_4^+ and PO_4^{3-} with concentrations of 5.36 and 5.12 mg/l, respectively. The WQI index of groundwater was 208.5, which reach to "Very Poor" level of standard. Pollution distribution was usually near the canals, vegetable fields and the graveyard area. Therefore it affected to the nitrate concentration in vegetables. All 16 vegetable samples have NO_3^- concentration exceeding the permitted standard. The 8th sample of water spinach contained the most NO_3^- content that exceeded 2.8 times the WHO and EC standards. Contaminated vegetable samples have negative effects on human health so the technical and planning solutions should be proposed to tackle this problem.

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CHẤT LƯỢNG NƯỚC VÀ DƯ LƯỢNG NITRATE - NITRITE TRONG MỘT SỐ LOẠI RAU ĐƯỢC TRỒNG GẦN NGHĨA TRANG TẠI THANH TRÌ, HÀ NỘI, VIỆT NAM

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TÓM TẮT

Xã Vĩnh Quỳnh, huyện Thanh Trì, Hà Nội nổi tiếng là một trong những nơi cung cấp nhiều rau cho người dân Hà Nội, nhưng các loại rau trồng gần khu vực nghĩa trang lại chứa đựng nhiều nguy cơ tiềm ẩn. Để đánh giá chất lượng nước và tồn dư của hàm lượng nitrat và nitrit trong ba loại rau: rau muống, rau cải xoong và rau cần, nghiên cứu đã lấy 12 mẫu nước mặt để phân tích pH, TSS, COD, NO_2^-, Fe, NH_4^+, PO_4^{3-} và NO_3^- và 10 mẫu nước ngầm để phân tích pH, Fe, NO_2^-, NO_3^-, NH_4^+ và PO_4^{3-}. Ngoài ra, 16 mẫu rau (10 mẫu rau muống, 3 mẫu cải xoong và 3 mẫu rau cần) đã được thu thập, sử dụng phương pháp chiết và lên màu hóa học để phân tích nồng độ nitrat và nitrit trong rau. Kết quả chính của nghiên cứu bao gồm: (1) Nước mặt bị ô nhiễm các chỉ tiêu Fe, PO_4^{3-}, NO_2^-, NH_4^+, COD, TSS và NO_3^- trong khi nước ngầm bị ô nhiễm 4 chỉ tiêu: Fe, PO_4^{3-}, NO_2^-, và NO_3^-. Trong đó nổi bật nhất là nồng độ NO_3^- và PO_4^{3-} trong nước mặt, nơi gần với nghĩa trang nhất vượt 18 lần mức cho phép. Chỉ số WQI của nước ngầm được đánh giá ở mức rất kém là 208,5. Sự ô nhiễm nguồn nước ngầm có thể do sự thẩm thấu nguồn ô nhiễm từ nước mặt khi hệ số tương quan của nồng độ NO_3^- trong nước mặt và nước ngầy rất cao (r = 0,972); (2) Mặc dù các mẫu rau không hiện màu khi phân tích NO_2^- tuy nhiên tất cả các loại rau đều có nồng độ NO_3^- vượt mức cho phép của WHO và EC. Mẫu rau M8 (rau muống 8) và K1 (rau cần 1) nằm gần nghĩa trang nhất có hàm lượng NO_3^- cao nhất lần lượt là 742 và 728 mg/kg tươi, vượt gấp 2,5 lần ngưỡng an toàn của WHO và EC.

Từ khóa: Chất lượng nước mặt, chất lượng nước ngầm, nghĩa trang, tồn dư nitrat – nitrit trong rau, xã Vĩnh Quỳnh.

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