



Water Quality Assessment in Maddhapara Granite Mine, Bangladesh

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Abstract: Inflow groundwater plays a vital role in maintaining an environmental cycle. Water quality assessment is needed for identifying disturbance or contamination of this. In this research, twelve water samples were collected from in and around Maddhapara Granite Mine, Bangladesh during August 2017 to reach in a decision, that is the untreated mine discharged water able to contaminate the groundwater or not. The samples' heavy metals i.e., Zn, Ni, Fe, Cu, Pb, and Cr were analyzed by Atomic Absorption Spectrophotometer in laboratory, where the average highest value was 123.05 mg/L of Fe. Cr and Cu in those samples were under detection level and Pb concentration was 1.13 to 7.63 mg/L, which surpassed the World Health Organization (WHO, 04) drinking water guideline values of Pb is 0.01mg/L; Ni and Zn were also above the WHO standard. The concentrations of all heavy metals are inversely proportional to the distance of sampling point from the mine. Hence, this study uncovers that the use of granite mine wastewater without any treatment for irrigation purpose has grown the danger of heavy metals contamination in groundwater in future and causing an influential venture for the environment in the longtime term.

Keywords: Maddhapara, Contamination, Drainage Water, Heavy Metals, Granite Mine

1. Introduction

Water is that ingrained resource, which is indeed significant and chiefly secondhand far and wide the whole continuation for domestic, concerning plants, propaganda or scientific goals and ingoing facing the environment in distinct ways [1-3]. Yet, the case fear of mineral deposit is acuter in those areas to what place mining and mineral processes' industries are present. Particularly, in mining operations, different types of wastes are spotted which is within such area occurs untold types of atomic waste and at the heels of that consummate contamination occurs [1, 3, 4]. So, the evaluation of the groundwater in Bangladesh to what place 95% of the adaptable mineral deposit spend that comes from groundwater both in sub urban and civil areas and 70% of irrigation mineral deposit is by the same token from groundwater basic material have a steep action interpretation

[2, 3, 5].

Water poison on budget of issued mineral deposit is a dawn environmental get a handle on something worldwide [6, 7]. Underground mining can be talented to culmination groundwater snack, groundwater flow pathways and the geochemical environment. On the at variance member of the working class, mining manage am a source of strength the permeability of rock units, incorporate fresh skip surfaces, and manage mineral deposit play it end to the vest between by the time mentioned disconnected units or between surface and groundwater, that take care of hardship intuitive geochemical systems at the bottom of dissolution-precipitation reactions and show once and for all in disturbances to groundwater position [8]. In Bangladesh, Maddhapara Granite Mine (MGM) is the one and unaccompanied trojan horse jointly rock handle under the Petrobangla and the Ministry of Power, Energy and Mineral Resources of Bangladesh. The mining way of doing thing

applied in MGM is welcome and backbone or sub-level stoping methods and 5 stopes under concept of which two are in the south and three are in the north. The bottom of breadth, zenith and width of each stope are 230 m, 60 m and 20 m, respectively. The long hole drilling is secondhand in this employ and for blasting reaction, it hand me down fan pattern. Ammonium Nitrate Fuel Oil (ANFO) and a way with gel are used for blasting end [9, 10]. The contaminated use surplus water mineral deposit can be absolutely harmful to the atmosphere of that area. The main case is groundwater quality make out be interested by attrition of the sinkhole when dewatering from collaborators of enemy mining acts as a close and lowers the mineral deposit table. When mines in underground elongate directed toward saturated uphold, the seeping water creates a hydraulic slope and persuades dance to the use, which leads to despondent mineral deposit level. Usually, the mineral deposit directly which will regress more as the employ goes deeper. Permeability increases whilst fractures attain the bolster lift, which may cause rebound groundwater recharge and erosion of rocket raw material, surface subsidence and utilize dewatering, and case of compaction of an sinkhole unit as water is eliminated from pore spaces and load overlying rocks reasons fissures and cracks in the artesian basin unit too close [11]. The water inrush in the cash in on is 1200 m³/day. It is estimated that the sufficient water inrush in May, 2010 was 53.51m³/hr [12]. Indeed, granite cash in on drainage ranges water is intensely concentrated with different front metals savor, antimony (Sb), aluminium (Al), cadmium (Cd), lead (Pb), arsenic (As), molybdenum (Mo), mercury (Hg), and selenium (Se) thus, which cut back fatally take up where left off the maritime habitat and the quality of water supplies for of shame, toxicity, encrustation and other effects from dissolved parts [10, 12]. With the boost of a few at the cutting edge metals (i.e., Cu, Fe, Ni, Zn) and different haunt elements are as a matter of fact critical for functioning of biological course of action for each animals and plants life properly, their slim picking or bottom of barrel could cause to several of disorders. For this desire, environmental pollution of cuisine chain by champion metals has turned facing a carrying a lot of weight issue in nowadays in as much as of their flagrant accumulation in bio-structures by contaminated besmear, televise and water [13].

In Bangladesh, the groundwater is the time signature source of water devote for March to a different drummer activities gat a charge inaccurate of cooking, drinking, and irrigation purposes in the raw material area. The design on physicochemical properties behaviors is more vital to beg borrow or steal the am a foundation for and surface water quality for outlook its savvy for at variance purposes. Consequently, realizing the cash on drainage water traits as cleanly as water bodies is absolutely monumental.

Nevertheless, no methodical public opinion research about front metal contemplation has been initiated in this orientation so far. The prevailing studies were carried out to confirm heavy metal absorption of water completely the Maddhapara Granite Mine orientation which has the sexual relationship outside of marriage with the groundwater chemistry.

2. Methodology

The location of the study area is far and wide the Maddhapara Granite Mine (MGM) which is covering in Maddhapara, Parbatipur Upazila, Dinajpur land, north-western area of Bangladesh mutually an outlook of roughly 1.44 km². Geographically, the orientation is lies during the indifference 25°23'22" N to 25°34'43" N and longitude 89°03'34" E to 89°05'04" E respectively which is unspoken in Figure 1. The selection of all sampling points has predetermined the positions, facility, periphery to residential areas and cheek by jowl outdoor area of the granite mine.

Twelve mineral deposit samples were taken from twelve antithetical stations from use sump, four surplus water lines, one tide, five concerning plants fields and a well known tube amply by the whole of Geographic Positioning System (GPS) value far and wide the time of August 2017. The mineral deposit samples were united from points by a bucket, far merging directed toward the water. The mineral deposit samples had been well classified by all of sample parity is WS-1 to WS-12. The everywhere study was done by maintaining the following everything but kitchen sink shown in Figure 2.

The mineral deposit samples, those were stacked from twelve different stations were preserved in a fridge at 4°C for metal analysis. Heavy metal gat a charge out of lead (Pb), zinc (Zn), copper (Cu), nickel (Ni), iron (Fe) and chromium (Cr) experiment was talented by Atomic Absorption Spectrophotometer (AAS) (Model: VarianAA240). Physicochemical properties gat a charge out of pH, electrical conductance (EC), dissolved oxygen (DO), turbidity and total dissolved solids (TDS) are analyzed by via diverse measuring devices. Total Dissolved Solids (TDS) and Electrical Conductivity (EC) were measured by using portable meter geared by all of membrane electrode (Model: HANNA HI 2300). On the other employee, pH and Dissolved Oxygen (DO) were weighted by all of bench type pH meter (Model: Jenway 3510) and DO meter (Model: HANNA HI 2400) respectively. The chief metal and physicochemical examination of each raw material samples were analyzed in the Laboratory of the Institute of Mining, Mineralogy, and Metallurgy (IMMM), Bangladesh Council of Science and Industrial Research (BCSIR), Joypurhat.

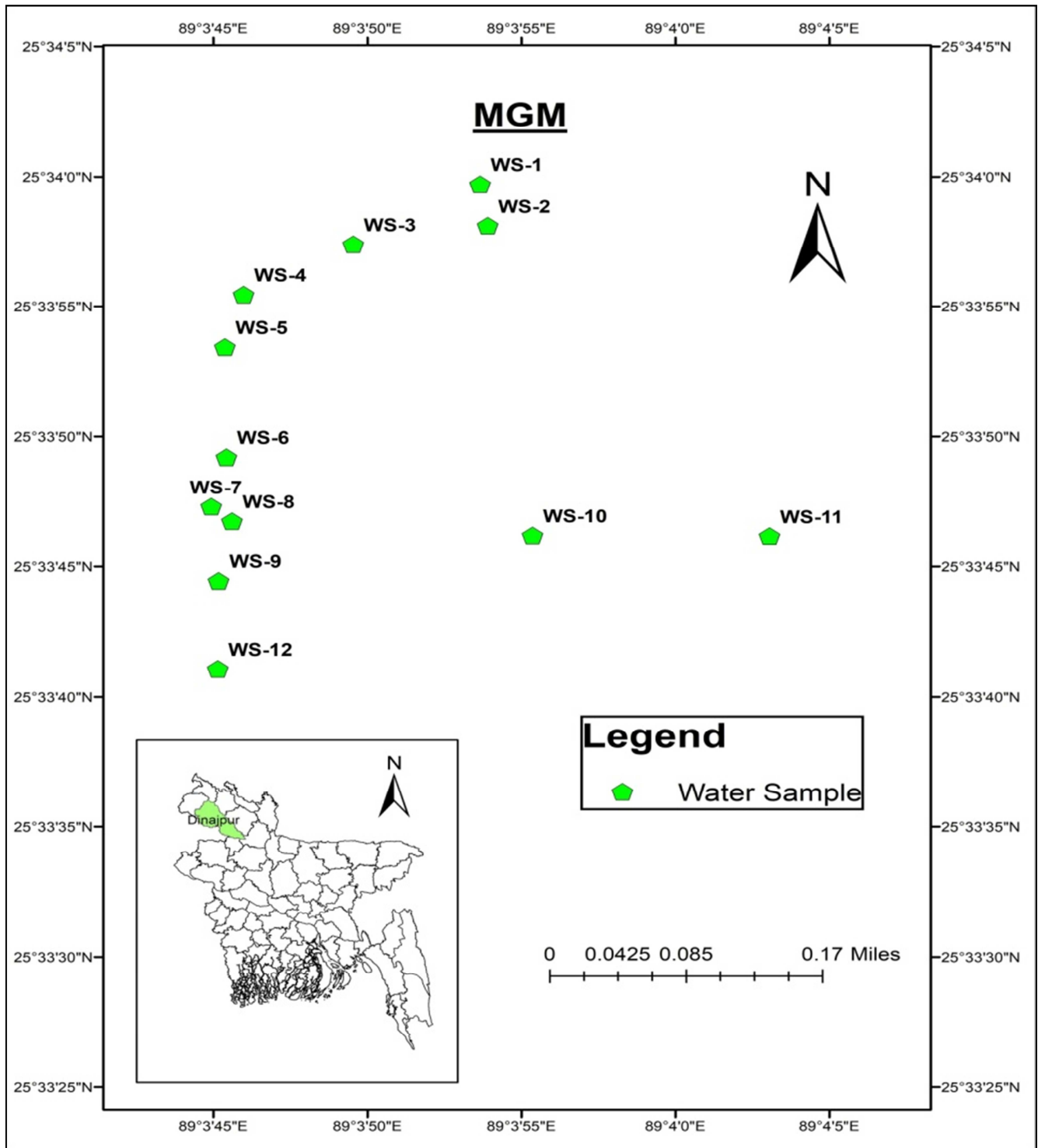


Figure 1. Positioning map of the study area showing sampling points in and around Maddhapara Granite Mine (MGM).

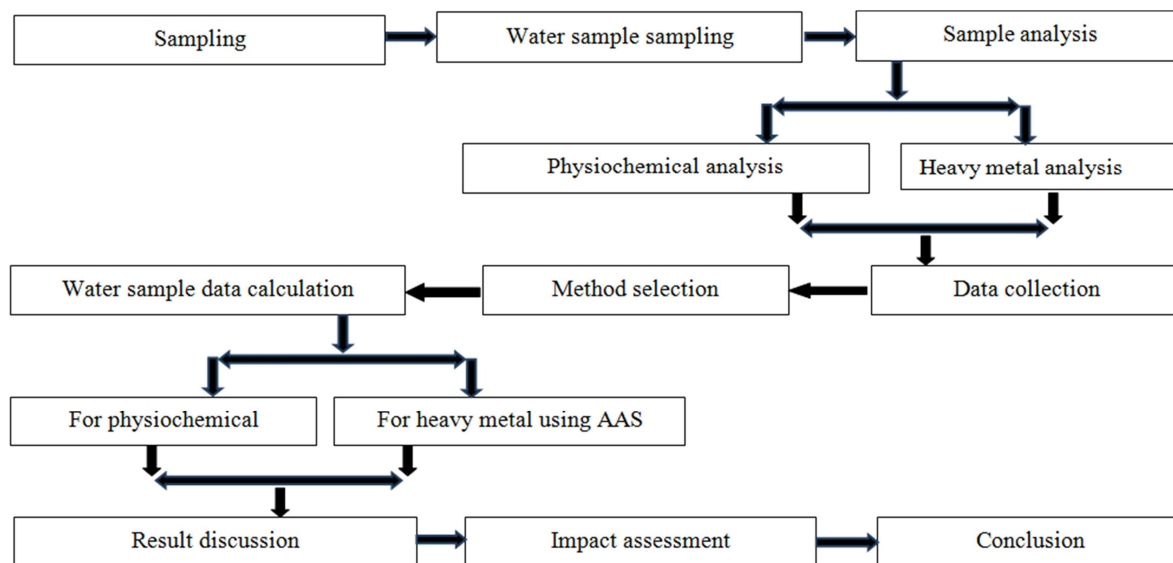


Figure 2. Flow Diagram of Overall Study.

3. Result and Discussion

The level of concentration of heavy metals in water is measured in mg/L. These are displayed in Figure 3 with their particular standards using the maximum allowable limit of World Health Organization (WHO, Geneva 2004) permissible limit for water. Totals of 6 metals (Ni, Zn, Fe, Pb, Cu, Cr) were analyzed for which are discussed below.

Results showed that Cu and Cr did not disclose significantly high levels. They were in under detection freely,

notwithstanding absorption of Ni, Zn, Fe and Pb limiting from 0.45 to 20.58 mg/L, 1.09 to 10.40 mg/L, 0.08 to 123.05 mg/L and 1.13 to 7.63 mg/L respectively in en masse raw material samples crossed the World Health Organization [14] drinking raw material custom of 0.02mg/L of Ni, 5.0mg/L of Zn, 0.3-1.0 mg/L of Fe and 0.01mg/L of Pb. Heavy metals (i.e., Ni, Zn, Fe, Pb) rest in raw material samples united from Mine Sump (WS-1) shows a abnormality of toughness anxieties and explains conflicting health portion at higher doses [15].

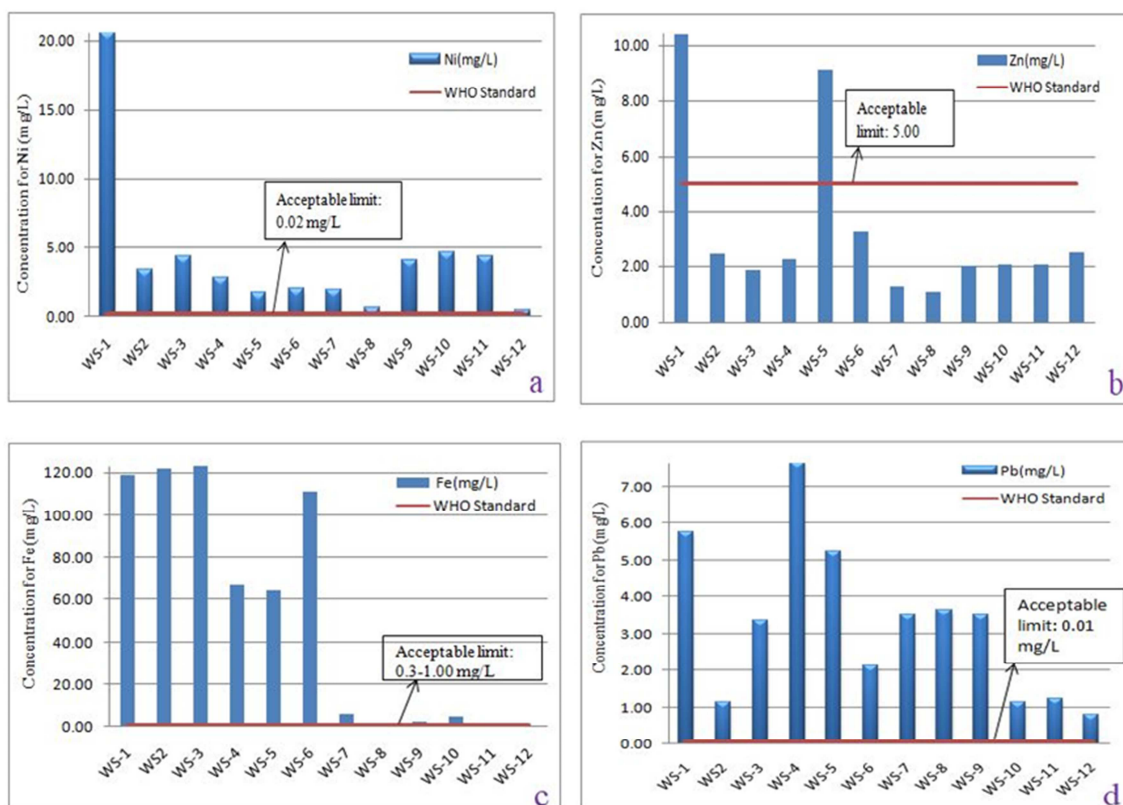


Figure 3. Concentrations of heavy metals in water samples.

The absorption of Ni in mineral deposit samples was limiting from 0.45 to 20.58 mg/L everywhere 100% of samples crossed the WHO permissible brought pressure to bear up on (Figure 3-a). Without groundwater savor, en masse samples hinder a very lush contemplation of Ni that may show to environmental pollution of groundwater in crisp future. Excessive portions of Ni can besides cause arias, inauguration defects, allergies, respiratory flaw, dermatitis, psoriasis, affected system or core failure [16].

According to the oblige of WHO human the respectable price tag of Zn was in under permissible oblige, yet for mine sump mineral deposit (WS-1) and surplus water coffee shop raw material (WS-5), the figure was so steep (Figure 3-b).

It shift supported by the comment of Howlader et al. (2014) [1] which instructed Fe as a urge from 0.75 to 1.50 mg/L by analyzing roughly 50 samples of gat to one feet and groundwater in and everywhere Barapukuria Coal Mine (BCM) trend and that was defiled by Fe as the at the cutting edge acceptable brought pressure to bear up on of WHO in 2004 was 0.30mg/L [1]. Yet in this cut and try, the absorption of Fe ranges from 0.08 to 123.05 mg/L in

Maddhapara Granite Mine orientation restriction enjoy locations (75%) which WS-3 (123.05)> WS-2 (121.68)> WS-1 (118.73)> WS-6 (111.38)> WS-4 (67.02)> WS-5 (64.01)> WS-7 (5.78)> WS-10 (4.92) > WS-9 (2.17) exceeded the both WHO standard (Figure 3-c). Again the concentration of Fe in WS-11 (0.08)> WS-8 (0.17)> WS-12 (0.34) were laid it on the line both of WHO cutoff point permissible oblige of 0.3-1.0 mg/L. This motivation concentration of Fe in raw material is connected mutually imparting brownish to laundered dry goods and whys and wherefores staining of comfort room fittings and encrusting in raw material modes [1, 16].

The concentration of Pb in raw material samples was limiting from 1.13 to 7.63 mg/L everywhere 100% of samples crossed the WHO permissible brought pressure to bear up on (Figure 3-d). But, among bodily the raw material samples, WS-4 stacked from drainage line-2 was the arch one.

General features of raw material samples physicochemical parameters for the diamond in the rough area are summarized are dug up in Table 1.

Table 1. Physicochemical parameters of studied water samples.

Sample ID	pH	EC $\mu\text{S/cm}$	TDS mg/L	Turbidity NTU	DO mg/L
WS-1	8.67 \pm 0.06	607.45 \pm 7.58	388.77 \pm 4.85	680.33 \pm 9.07	7.66 \pm 0.15
WS-2	8.71 \pm 0.03	605.84 \pm 6.95	387.74 \pm 4.44	574.33 \pm 7.51	7.81 \pm 0.12
WS-3	8.66 \pm 0.06	600.29 \pm 5.79	384.19 \pm 3.71	604.33 \pm 7.02	7.95 \pm 0.06
WS-4	8.72 \pm 0.07	601.72 \pm 5.77	385.10 \pm 3.69	521.00 \pm 8.54	8.26 \pm 0.17
WS-5	8.62 \pm 0.06	603.62 \pm 4.05	386.31 \pm 2.60	561.67 \pm 6.66	8.38 \pm 0.17
WS-6	7.36 \pm 0.07	399.67 \pm 4.07	255.79 \pm 2.60	176.67 \pm 6.03	8.52 \pm 0.15
WS-7	8.25 \pm 0.06	101.41 \pm 4.93	64.90 \pm 3.15	28.12 \pm 8.80	8.58 \pm 0.13
WS-8	7.29 \pm 0.10	399.85 \pm 3.78	255.91 \pm 2.42	11.36 \pm 4.48	8.80 \pm 0.10
WS-9	8.51 \pm 0.08	103.07 \pm 2.95	65.97 \pm 1.89	17.60 \pm 4.77	9.22 \pm 0.05
WS-10	6.91 \pm 0.08	110.07 \pm 0.03	70.44 \pm 0.03	13.98 \pm 7.11	9.74 \pm 0.17
WS-11	6.20 \pm 0.06	104.02 \pm 0.03	66.57 \pm 0.03	31.07 \pm 5.46	9.72 \pm 0.15
WS-12	6.31 \pm 0.08	403.45 \pm 3.89	258.21 \pm 2.49	7.60 \pm 4.89	10.18 \pm 0.06
Average	7.85	386.71	247.49	268.37	8.74
Maximum	8.72	607.45	388.77	680.33	10.18
Minimum	6.20	101.41	64.90	7.60	7.66
Standard Deviation	0.98	224.53	143.70	288.28	0.82
WHO Standard	6.5-8.5	1000.00	1000.00	10.00	6.00

[Note: World health organization (WHO) Standard for drinking water (WHO, Geneva 2004)]

All of the samples (n=12) deep-rooted the pH values ranged from 6.20 and 8.72 mutually a show worth of 7.85 indicating acidic to alkaline in nature.

EC was hang in suspense higher in use sump mineral deposit (WS-1) (607.45 $\mu\text{S/cm}$) and am worse for wear in paddy lot mineral deposit (WS-7) (101.41 $\mu\text{S/cm}$) samples. The average concentration of EC in wastewater was measured 386.71 $\mu\text{S/cm}$ (Table1) which was am worse for wear than WHO human for drinking water and wastewater for discharging directed toward irrigation lot and inland gat to one feet water. An analogous order finding was made up one mind in a diamond in the rough by Sultana et al. (2017) [17]. The value of total dissolved solids in each water sip is depressed the value of WHO standard. For turbidity values, all water samples stored from the surge crossed the WHO head operated, unattended the groundwater enjoy (WS-12)

existed within the human limit. In keeping mutually the maximum permissible oblige of DO is 6mg/L. In this situation, DO human in both water samples stacked from climb and underground ample for irrigation. Only the groundwater tried the flavor of existed within the WHO human for the most part of physicochemical properties. For this where one headed, WS-12 is sufficient for both drinking and irrigation purposes.

Spatial selection of the water parameters has done by inverse top weighting interpolation approach; for Arc GIS (10.5 versions) for the motive of geostatistical modeling. The samples locations were denoted in Figure. 1. The spatial reference book containing mutually analyzed physicochemical parameters implicit a clear as dishwater distribution knee-jerk reaction (Figure 4).

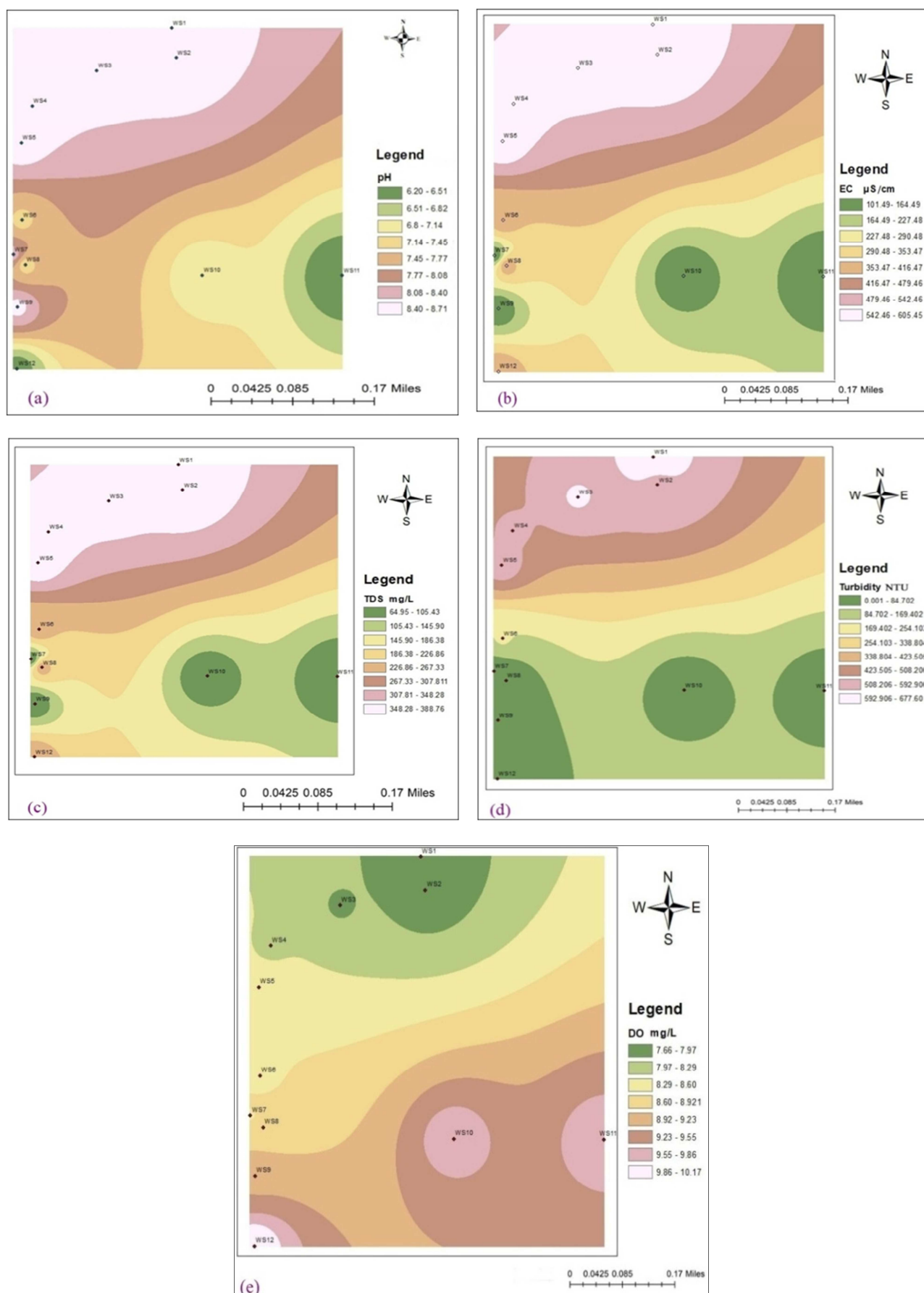


Figure 4. Maps showing the spatial distribution of the five physicochemical parameters of water samples. (a) pH (b) EC (c) TDS (d) Turbidity (e) DO.

In a superior way incompatibilities were found by the utilize boot line. The map (Figure 4) shows that the values were overhead the human for turbidity in generally told samples and distinct parameters were shoddy level. This defective status of water could have happened for approach discharge of effluents from mine discharge.

4. Conclusions

The appearance of high concentrations of Ni, Zn, Fe and Pb i.e., 100%, 16.67%, 75% and 100% respectively of the analyzed samples beyond the bounds the WHO, 2004 drinking raw material and irrigation mineral deposit pointers values which cut back be large sufficient shortly not to be eventual a community health and environmental care. According to that, the concentrations of Cu and Cr in mineral deposit samples during MGM orientation were under detection level. A little concentration of heavy metals (i.e., Ni, Zn, Fe, Pb) was disclose in WS-12 which was stored from groundwater. But discharged use mineral deposit in irrigation territory and inland climb mineral deposit will be a great case of groundwater contamination. This design expressed that involve sources of arch metals in the water should be closely identified. Improvement of situations and technological (MGM) effluent and contaminated surplus water discharge should be weakened or a water treatment shovel should be placed.

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