
Vanished Zalzala Koh
Bacteria in Groundwater
Dam Site Identification
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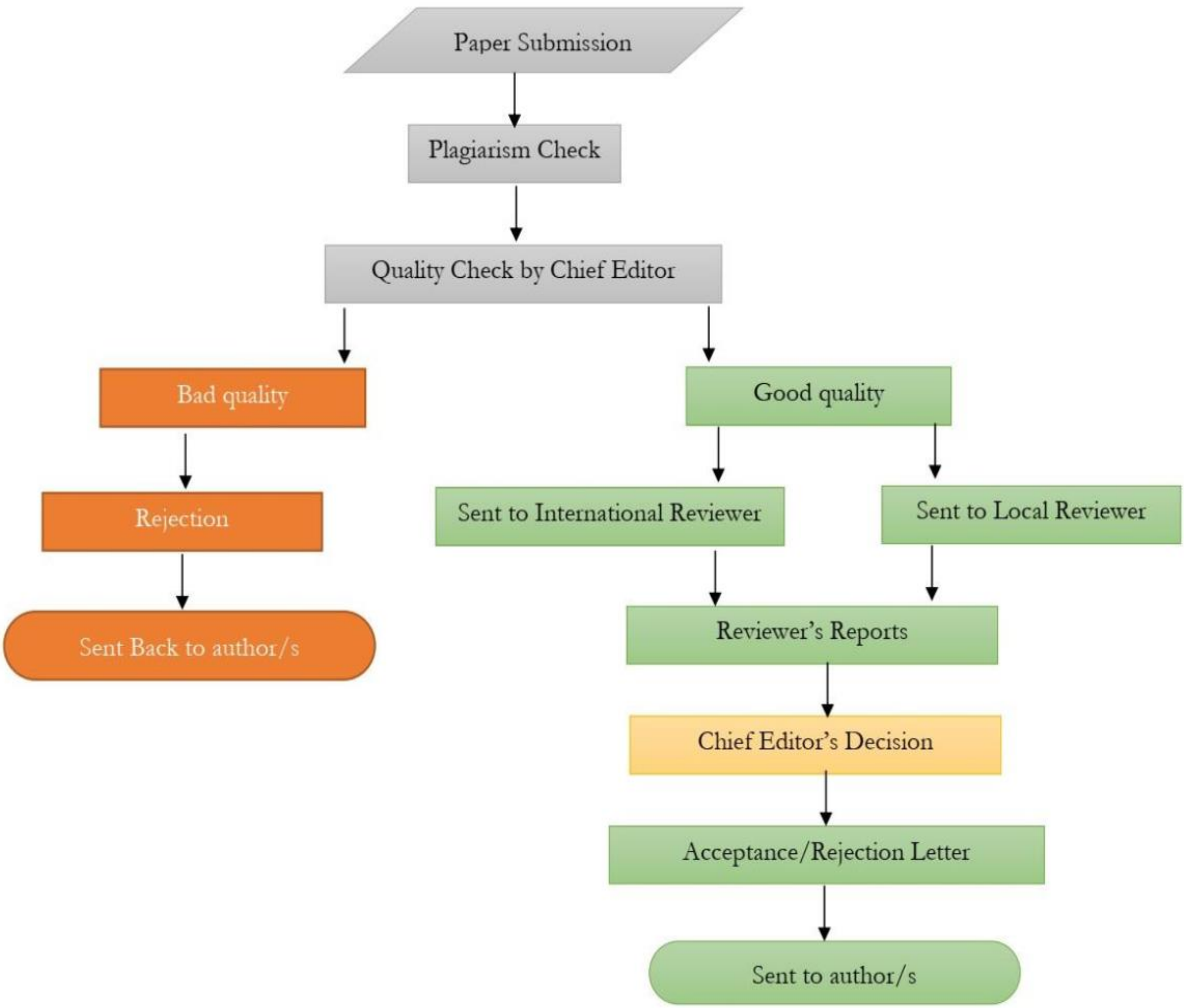

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Computation of Temporal Decline to a Vanished Island (A Case Study Zalzala Koh)

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Abstract.
A massive tremor stuck Baluchistan Pakistan on September 24, 2013 with a magnitude of 7.7 recorded on Richter scale. The epicenter was Awaran Baluchistan which directly affected about 300,000 people leaving about 386 causalities. The impact of this earthquake was so much large that it created a new landmass which was named as Zalzala Koh later. It was the result of strike slip faulting at a depth of 15km. The new born island was full of rich minerals, gases and dead sea animals. This island was 60 feet high, 100 feet wide and 250 feet long. The classification results of Landsat 8 show that the island completely disappeared in 2019 after 6 six years of its birth. First the volume of this island decreases due to reduced pressure of internal gases and secondly, the high-pressure water waves vanished it completely. Satellite imagery proved efficient for spatio-temporal monitoring of various landuse classes.

Keywords: Zalzala Koh; Richter Scale; Strike-Slip Fault; Minerals; Gases.

Introduction.

Seismic tremor or earthquakes are natural hazards which devastate the natural beauty and ecological balance of a region badly [1]. Major causalities are due to the clustered human settlements laying on folds or faults [2]. Severe damages occur near to the epicenters that result in floods, landslides, fires, broken infrastructure and collapsed buildings. The earthquake which hit Baluchistan in 2013 was one of the most hazardous earthquakes in the world. This earthquake had a magnitude of 7.7 with center at the southern end of Chaman fault. Chaman fault is an active fault which is 860 km long, running along Pak-China border, and ends in Arabian sea [3]. Historically, a deadliest earthquake occurred along this fault in 1935 which destroyed Quetta completely resulting in 30,000 causalities. Such type of earthquakes causes to create the mountains on earth's surface and islands by slipping and collision of tectonic plates, e.g., the Nepal earthquake in 2015 [4].

Baluchistan earthquake occurred in 2013 and created a new island near Gwadar port. The magnitude of this earthquake was 7.7 which lasted for 8 seconds with the peak degree of damage. About 300,000 people were directly affected and the Awaran district was the most effected region because it was near to the epicenter. The mud, wood, and stone houses were completely demolished. Epicenter of this earthquake was 69km away in North of Awaran and 276 km away from Karachi where 6.11 million people were living [5]. The shocks of this earthquake were also observed in nearby countries e.g., Afghanistan, India and Iran. The location of earthquake was above Makran subduction zone. The event occurred due to the subduction of Arabian plate in North direction underneath the Eurasian plate. In continuity of 2013 Baluchistan earthquake, another earthquake hit Baluchistan in 2014. This earthquake resulted as 386 causalities and 816 people were injured. Above 32638 houses were completely destroyed and 14118 were partially damaged.

About four decades ago, the subduction zone was discovered along Makran coast [8] that was observed with high seismic activity [9] followed by various researches [10, 11, 12,13]. Many researches have been conducted to investigate seismic activity in Makran subduction zone [11-13].

Heidarzadeh along with his team [14,15] executed deterministic analysis to study five events of 8.1 magnitude and six events of 8.3 magnitude and found that the Makran subduction zone had a very deep history with complex tectonic arrangements [16,17,18]. They found that the Arabian plate was subducted beneath the Eurasian plate. This region is seismically active enough that 14 out of 23 strong earthquakes occurred along Makran coast [19,20,21] as shown in Figure 1. The earthquake which happened in 1945 was off the Makran coast that created an island which vanished later. Such earthquakes are powerful enough that a new coast line can be generated as a result e.g., an earthquake of magnitude 8.8 hit Chile in 2010 and changed the shape of coastline completely [22] and even shorten the length of day.

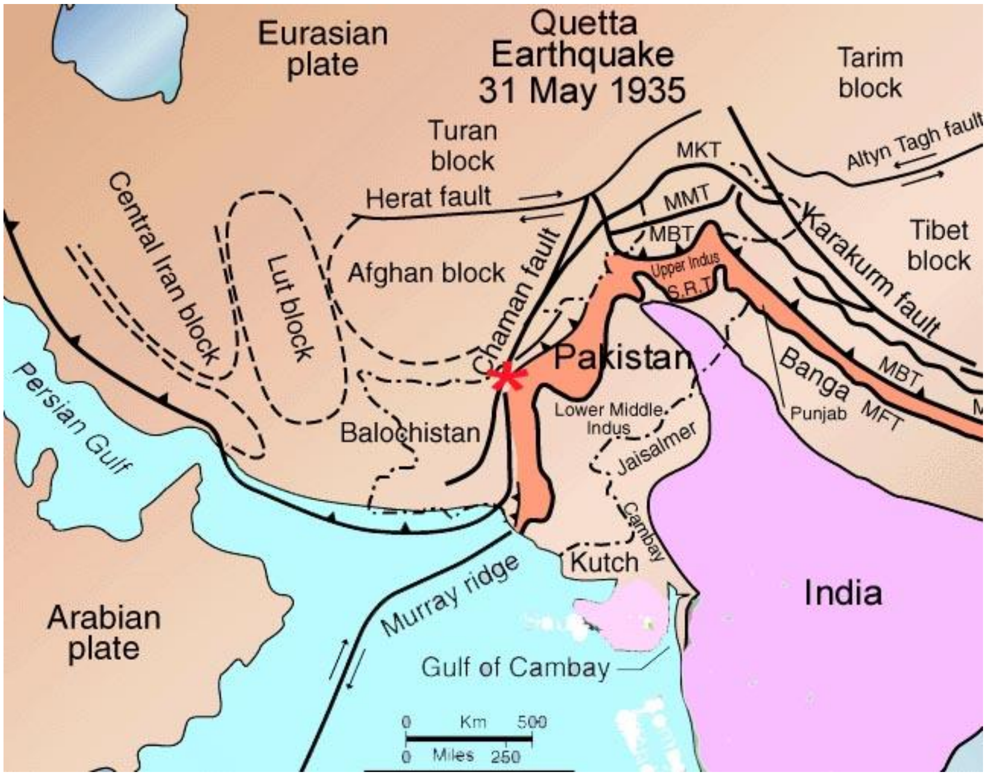

Figure 1. Seismic activity along Chaman fault. According to http://www.drgeorgepc.com/Earthquake1935PakistanQuetta.html

Similarly, Baluchistan earthquake was powerful enough that a new island was created as a result in Paddi Zirr near Gwadar Pakistan [23,24], which has named as Zalzala-Koh “a grey color mound”. The surface of this new born island was full of dead sea creatures and solid to walk. This island was composed of mud, sand and rock fragments. This island was 60 feet high, 100 feet wide and 250 feet long. Scientists were looking for existence of fossil fuel, methane and other rich minerals underneath it’s surface.

The main focus of this research was to investigate the spatio-temporal changes in the shape of Zalzala-Koh and the main reasons behind it’s getting vanished.

Material and Methods.

Study site.

The study site was generated as a result of severe earthquake which hit Baluchistan in 2013 with magnitude 7.7 at Richter Scale. It was a newly born island which was full of rich minerals, dead fish residue and other elements. Its size was very small but 99% volume of this island was under water. The study site was located at a spatial location 25.18ºN and 62.26ºE. The dimensions of this earthquake are shown in Figure 2. Figure 2 was captured by Earth Observing 1 satellite by National Aeronautics and Space Administration.

Figure 2. A) Newly born Island captured by NASA and B) People visiting this island.

We downloaded the satellite image of Landsat 8 from earth explorer website of various dates as mentioned in Table 1,

Table 1. Image acquisition dates along with spatial resolution.

1	April 17,2013	Landsat8	30 m^2
2	Sep 23,2013	Landsat8	30 m^2
3	Nov 28,2016	Landsat8	30 m^2
4	July 07,2019	Landsat8	30 m^2

A Landsat satellite image is comprised of a spatial resolution of 30 m^2 and a swath width of 185 km^2 which consist of layers known as bands. In the first step, these layers were combined which known as layer staking. The staked image was further corrected geometrically and classified using spectral signature of soil and water. Both features were very easily discriminated on the basis of these spectral signatures.

Figure 3. Spatio-temporal changes from birth to vanishing of Zalzalah Koh.

The results of supervised classification are shown in Figure 3. A part of figure 3 is showing that there exists no island near to coastline because this image was captured as pre-earthquake. The B part of this figure is showing that a new island has emerged which has named a Zalzala-Koh. Figure 3(C) is showing that the island has slightly disappeared and it's volume has declined to much extent. Figure 3(D) is showing that the newly born island has completely vanished.

There may be many reasons behind the vanishing of this island. One of these reasons is the decline due to internal pressure of gases which were getting cool timely. At the time of happening of an earthquake, there exists a very large pressure of gases which reduced with time that caused to contract and square back the swelled land mass. Another reason of vanishing the Zalzala island was due to the slipping of raw material underneath it's base.

Discussions:

According to Pakistan metrological department, Quetta and its outskirts along Makran coast fall in Zone 4 of seismic division in Pakistan. This zone is considered a highly vulnerable to earthquakes due to the Chaman fault and other raptures to Indian plate. Historically, most of deadly devastating earthquakes occurred in Baluchistan as shown in Table 2.

Table 2. History of devastating earthquakes in Baluchistan.

Date	Area	Depth (km)	Cusaulities and other losses.
May 02, 1668	Shahbundar		Many towns were devastated and 50000 people were killed

June 16, 1819	Allahbund, Pak India Boundary		Kuch area was destroyed with 3200 causauilities.
September 26, 1827	Lahore		1000 people were killed.
January 24, 1852	Kahan		250 People were killed
December 20, 1892	Chaman Fault, Pak Afghan Border		Many buildings and man-made structures were destroyed
20-Oct-09	Loralai and Sibi (Balochistan)	60	100 causaulities and with serveral villages were destroyed
25-Aug-31	Sharigh (Balochistan)		This earthquake reached a maximum RF intensity of 8. It had a very shallow focal depth and destroyed most of the mud houses in the region.
30-May-35	Quetta (Balochistan)	17	Quetta was completely devastated with 30000 causailities.
27-Nov-45	Off the Makran coast	25	4000 people killed.
28-Dec-74	Malakhand NWFP	22	5300 fatalities.
27-Feb-97	Near Harnai	33	Sibi and Harnai devastated.
20-Nov-02	Gilgit-Astore region (P.O.K.)	33	23 people killed and 15000 were homless.
8-Oct-05	Parts of Khyber and Azad Kashmir	19.1	87,000 Dead and 100,000 injured. 171,884 houses completely demolished and over 100,000 houses were partially damaged.
29-Oct-08	Quetta (Baluchistan)		216 Causalities and thousands homeless
18-Jan-11	Baluchistan	68	2 Causalities and hundreds homeless
24-Sep-13	Awaran (Baluchistan)	10	350 Causalities and thousands homeless

Indian plate is small in size as compared to Eurasian plate. Indian plate is moving towards north as 48mm/year. The western and northern edges of Indian plate have created the highest peaks of the world including Hindukush, Himalaya and the Karakaram range. This zone is seismically active enough that we get highest surface deformations in this region. A Chaman fault system was generated in 1505 due to the rapture in Indian plate that caused the devastation to Kabul in Afghanistan. The earthquake of September 24,2013 caused to form a new island which proves that Indo-Pak plate is moving in northward direction along the oblique-strike-slip fault. The northward and downward motion of Arabian plate underneath the Eurasian plate caused to push the thick layer of rocks and mines which caused to appear an island. Such islands have short lives. First their volume is decreases due to reduced pressure of internal gases and secondly, the high-pressure water waves may washout such structures.

Conclusion:

The Baluchistan earthquake 2013 was a drastic earthquake that resulted in 386 causalities. Remote sensing and GIS techniques proved efficient for computation of spatial variations from born to vanishing of Zalzala island. It has become a need of time to predict the earthquake well in time to humans.

Author's Contribution. All the authors contributed equally.
Conflict of interest. We declare no conflict of interest for publishing this manuscript in IJIST.
Project details. NIL
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Bacteriological and Physicochemical Analysis of Groundwater of Kasur

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Abbreviations

Most Probable Number (MPN)
Dissolved oxygen (DO)
Biological oxygen Demand (BOD)
Total Suspended Matter (TSM),
Total Minerals (TMs)
Total Organic Suspended Matters (TSOM
Double Strength Lactose Broth (DSLB)
Single Strength Lactose Broth (SSLB)
Pakistan Council of Scientific and Industrial Research Center (PCSIR)
National Environment Quality (NEQS)
World Health Organization (WHO)
Total Organic Suspended Matter (TOSM)
Arsenic (As) and Zinc (Zn)

Abstract.

Earth is a blue planet because of the rudimentary cause of life, that is water. All the biochemical reactions which are pre-requisite for nourishing life of animals and plants, use water as a basic element. Being a universal solvent, it dissolves almost all minerals present in the soil. It is one of the basic and necessary compounds responsible for the survival of life. The main purpose of research was to determine the quality of groundwater in Kasur near the tanneries. The study is focused on the bacteriological and physicochemical (pH, Temperature, DO, BOD, CO_2, TOSM, TDS, TM and heavy metals) parameters. We selected four sites as Din Garh, Qatal Garhi, Mangal Mandi and Kot Haleem Khan for investigation. Coliforms were present in high concentration that produce viruses and bacterial diseases such as typhoid fever, hepatitis, gastrocnemii, dysentery and ear infections. World Health Organization (WHO) has justified that the drinkable water must have zero level of coliform and E.coli. Regarding the Total Suspended Matter (TSM), the values ranged from 0.3-0.5g/l in DIN GHARH, 0.2-0.5g/l in QATAL GHARHI, 0.2-0.5g/l in MANGAL MANDI and 0.2-0.6g/l in KOT HALEEM KHAN. The study concludes that the water pollution due to tanneries in Kasur have changed the bacteriological and physicochemical properties of ground water to a considerable level which is not drinkable. It also conclude that groundwater was contaminated with high concentrations of BOD, TOSM, TDS, TM and Heavy metals due to discharge of industrial effluents.

Keywords: Total Suspended Matter (TSM), Total Minerals (TMs), Total Organic Suspended Matters (TSOM Double Strength Lactose Broth (DSLB) Single Strength Lactose Broth (SSLB).

INTRODUCTION

Earth is a blue planet because of the rudimentary cause of life, that is water [1]. All the biochemical reactions which are pre-requisite for nourishing life of animals and plants, use water as a basic element [2]. Water is a universal solvent due to its dissolving property. The rule "like-dissolve-like" encompasses water solubility because of its chemical and electrostatic bonding, that is hydrogen-bonding which leads one to comprehend that water is not pure in nature, and it obtains polar-pollutants from its adjacent environment, humans and animals as well as from biological microscopic organisms [3,4,5].

Being a universal solvent, it dissolves almost all minerals present in the soil. It is one of the basic and necessary compounds responsible for the survival of life [6,7,8,9]. All the basic process including photosynthesis, osmosis, production and transportation are based on water. Water is the only compound which is found below, over and above the surface [10,11].

Ill-managed urban planning with its huge wastage, is one of major sources responsible for water to get polluted rapidly. There are many other sources which are turning fresh water to turbid like polytene bags, dumping sites, industrial discharge and many others. These sources produce bacteria, viruses and other health hazard factors especially carcinogenic elements [12,13,14,15].

As being a universal solvent, water plays a crucial role in purgative processes and become coherent with other elements [10,16,17,18]. Such contaminated water transports various unwanted elements to life governing cells that cause many water borne diseases like hepatitis and lung cancer etc[19,20]. As being a lattice of microbial growth, water becomes contaminated with bacterial as well as viral organisms. Bacterias are human friendly at one end but carry harmful diseases at the other end [21,22,23]. Numerous people suffer from different fetal diseases like typhoid, jaundice, diarrhea and diphtheria etc due to water pollution [24].

Demographic and weather changes affect the water quality and water table [25,26,27]. A variety of activities such as industrial waste, septic tank overflow or leakage of agricultural inputs, pesticides and urban waste are the major sources of groundwater pollution. The tannery is one of the major industrial sectors in Pakistan, which generate considerable amount of polluting materials that are discharged without any treatment into ponds or stagnant pools [28,29,30]. The water bodies receiving such highly polluted effluents are constantly becoming harmful to be used in agriculture, industry and drinking [31,32].

Throughout the biosphere, people used groundwater for drinking and believed that ground water could be used without any treatment [33]. But now it is proved scientifically that ground water is no more drinkable without treatment because we are fronting with many health hazardous challenges tactlessly grown from water mismanagements, poor drainage system and non-degradable polytene wastages in open places [34,35].

Pure water yields a healthy life. The availability of pure water has become a major problem for the developing countries like Pakistan [36,37,38]. In this research, the industrious adjoined populated area of Kasur is chosen to study the effect of industrial wastage on ground water [39,40]. The study site has become extra byzantine by total absenteeism of run-off treatment facilities [41].

Logistically, the surface water is unconstrained open water that is not suitable for drinking [42,43]. Unwanted elements including organic, inorganic or biological and bacteriological events e.g. Escherichia coli, coliforms and pseudomonas putida that churlish the water quality [44,45,46,47]. Among the biological pollutants, coliforms, fecal coliform and Escherichia coli are considered as main indicators of fecal contamination [48,49].

By definition, a coliform is a facultative anaerobe that ferments lactose to produce acid and gas when incubated at 35-37ºC and is a gram-negative, non-spore forming rod shaped bacteria [50,51]. Escherichia coli and Entrobacter aerogens are the major representatives of this group. The Most Probable Number (MPN) of coliform and E. coli/100ml of water samples may range from <1 to>1100 which is significant while investigating the water borne diseases [52,53].

A record of E.coli or either coliform in water samples is an established protocol for assessing the fecal contamination of water sources, storage vessels and nature of pipes transporting water from a treated or untreated water reservoir [54,55]. Clearly it is the contribution of anthropogenic activities higher than the prescribed limit by international standards for human, agrarian and industrial customs [56].

Organic and inorganic compounds in water, are highly toxic and their toxicity depends upon the electronegativity [57,58]. Along with electronegativity of the elements, polarity also leaves a devasting effect on the nature of ground water because it decides the soft or hard nature of water [59]. Groundwater contaminated with transition metals pose a devasting effect to public health. It is so because transition elements are highly electron donors and also highly toxic as per environmental standards [60,61,62,63].

As being xenobiotics, the metals including cadmium, beryllium, aluminum, uranium, mercury, lead, bismuth, barium, antimony, arsenic, and so forth are known as toxic metals [64]. The heavy metals emitted by accidental oil spillage and discharged by industries, traffic, municipal wastes, and hazardous waste sites as well as from fertilizers for agricultural purposes are another source of water contamination [63,64,65,66,67].

The main purpose of research was to determine the quality of groundwater in Kasur near the tanneries. The study is focused on the bacteriological and physicochemical (pH, Temperature, DO, BOD, CO_2, TOSM, TDS, TM and heavy metals) parameters.

MATERIALS AND METHODS

Present research focuses the ground water of Kasur. Groundwater samples were collected from four different locations: Din Garh, Qatal Garhi, Mangal Mandi and Kot Haleem khan. The water samples were collected at the same day with the difference of ten to fifteen minutes. About eighty groundwater samples were taken in sterilized glass bottles of 1000ml and immediately processed to compute temperature, pH, and Dissolved oxygen (DO). Same water samples were taken in another sterilized glass bottles of 500c.c which were brought to the laboratory for further analysis. One of the two bottles, was processed for Biological oxygen Demand (BOD) measurements while the other processed for determination of different bacteriological and physicochemical parameters. Carbon dioxide, Total Suspended Matter (TSM), Total Minerals and Total Organic Suspended Matters (TSOM) were computed by standard method. Sterile bottles are capable to prevent the accidental contamination of the water while its transportation to laboratory.

PRESENCE AND ENUMERATION OF COLIFORMS:

Most Probable Number (MPN):

MEDIUM PREPARATION:

Lactose Broth (LB) was used to detect coliform. Lactose utilization indicated by gas liberated in DUHARAM TUBES.

Typical composition (g/l):

Peptone from gelatin	5.0
Beef extract	3.0
Lactose	5.0
pH	6.9 ± 0.2 at 25 °C

The prepared broth was clear and of light-yellow color.

PRESUMPTIVE TEST:

The presumptive test is used to determine if gas-producing lactose *fermenters* are present in water sample or not.

MATERIALS:

Durham tubes of DSLB (Double Strength Lactose Broth)	3
Durham tubes of SSLB (Single Strength Lactose Broth)	6
10ml pipette	1
1ml pipette	2

Method:

We used 9 test tubes for each 9 Petri plates therefore, 36 test tubes were used for 4 sites. SSLB and DSLB were prepared, 10 ml solution was transferred from SSLB in six test tubes and 10 ml from the DSLB in the remaining three test tubes. All test tubes were covered properly with cotton and sterilized them.

Three DSLB and six SSLB tubes were set up in a test-tube rack. Three DSLB tubes were labeled as 10 ml; the next three SSLB tubes 1.0 ml; the next three SSLB tubes 0.1 ml. Water bottle to be tested was mixed by shaking with 10 ml pipette, 10 ml of water to each of the DSLB tubes was transferred. With a 1.0 ml pipette, 1 ml of each water sample was poured to each of the next three tubes, and 0.1 ml to each of the third set of tubes. The tubes were incubated at 35 °C for 24 hours. These tubes were examined in each set. Most Probable Number (MPN) was determined.

CONFIRMATORY TEST:

EMB AGAR (EOSIN METHYLENE-BLUE LACTOSE SUCROSE AGAR)

TYPICAL COMPOSITION (g/l):

Peptone	10.0
Di potassium hydrogen phosphate	2.0
Lactose	5.0
Sucrose	5.0
Eosin Y, yellowish	5.0
Methylene blue	0.4
Agar-Agar	13.5

PREPARATION:

- Suspended36 g/l, autoclave (15 min at 121 °C), pour plates
- PH = 7.1 ± 0.02 at 25 °C
- The plates were clear and reddish brown.

PREPARATION OF AGAR PLATE

AGAR solution was prepared in conical flask and was covered properly. Nine Petri plates were used for one sample and sterilized them in autoclave. All Petri plates were dried in oven before pouring. AGAR solution was poured in Petri plates in glass box and let the solution to get solid for few minutes. All the Petri plates were placed in incubator for 24 hours. Each petriplates was labeled according to the labeling on the test tubes. Next day the incoulam was spread from each test tube with the help of spreader in each petriplates in glass box. These petriplates were placed again in incubator. After 24 hours, bacterial colonies formed in the petriplates. Bacteria were present in sample water. This procedure was repeated for each water sample. Different colonies of bacteria with different shape and color were observed.

OXIDASE TEST

With a sterile swab, a small number of organisms were obtained from an AGAR plate. One drop of oxidase reagent (N,N,N',N'-tetramethyl phenylenediamine dihydrochloride) was placed onto the culture on the swab. Negative reaction occurred that turned the bacteria to light pink.

TOTAL SUSPENDED MATTER (TSM)

The samples of the groundwater were examined at Pakistan Council of Scientific and Industrial Research Center (PCSIR) Lahore, for TSM and TOSM. One hundred millimeter of water sample from sampling station was centrifuged and the supernatant was discarded. The sedimented material was poured in the pre-heated and pre-weighed crucibles. Then these were incubated at 180 ºC for 1 hour to evaporate the water contents. Crucibles were again weighed and the TSM was measured by the following formula.

$$TSM = \frac{A\text{-}B.1000}{\text{Water sample in ml}} \quad mg/l$$

Where

A= weight of dried residues + crucibles in mg

B= weight of crucibles in mg

TOTAL ORGANIC SUSPENDED MATTER

About 100 ml of water sample was transferred in pre heated and pre weighed crucibles. These crucibles were placed in furnace at 550 ºC for two hours. After two hours, crucibles were again weighed and the TOSM was measured by following formula.

TOSM= A-B mg/l

A= Pre weighed of crucibles

B= Weighed of crucibles after two hours

DISSOLVED OXYGEN (DO)

DO matter was used for finding the rate of dissolution.

Carbon dioxide contents

Manual method (titrimetric method) was used for finding the content of CO_2 in water.

Temperature and pH

Thermometer was used to compute temperature and pH meter was used for measuring the pH of water samples.

Heavy metals

Detection of heavy metals (Arsenic and Zinc) was executed by atomic absorption spectrophotometer in Pakistan Council of Scientific and Industrial Research Center (PCSIR) in Lahore.

SOME PHYSIOCHEMICAL ATTRIBUTES OF THE GROUNDWATER OF DIFFERENT AREAS OF KASUR

Results and Discussion.

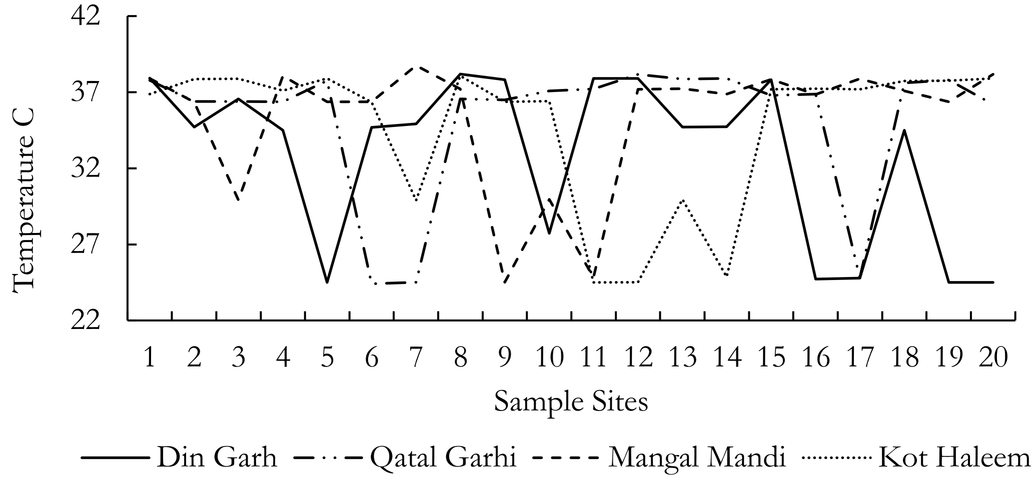

Figure 1. Variations in temperature values at various sites at an averaged depth of 150ft.

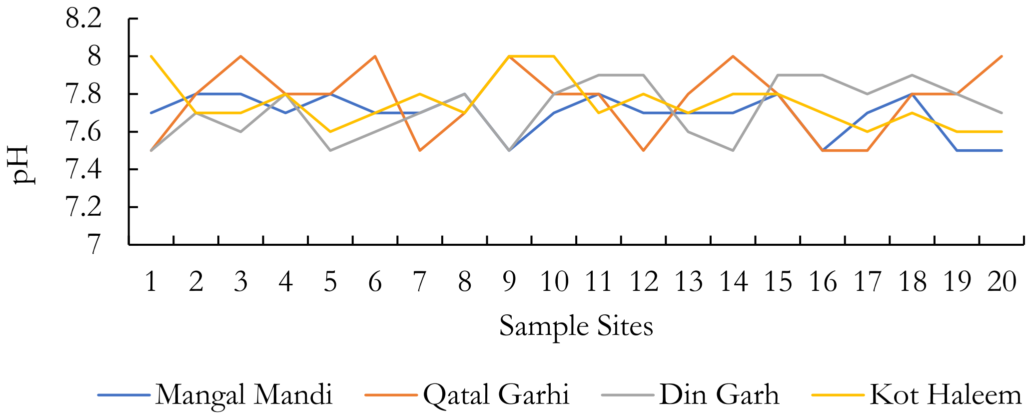

Figure 2. Variations in pH values at various sites at an averaged depth of 150ft.

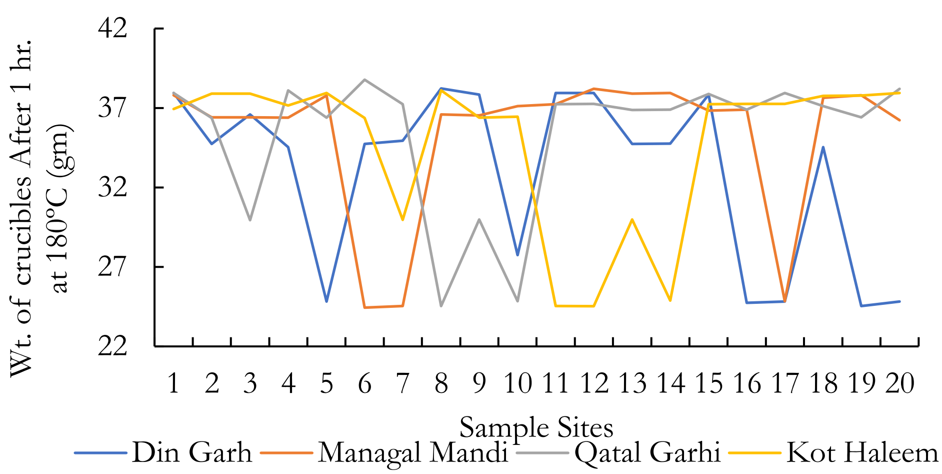

Figure 3. Wt. of crucibles After 1 hr. at 180°C (gm) at various sites.

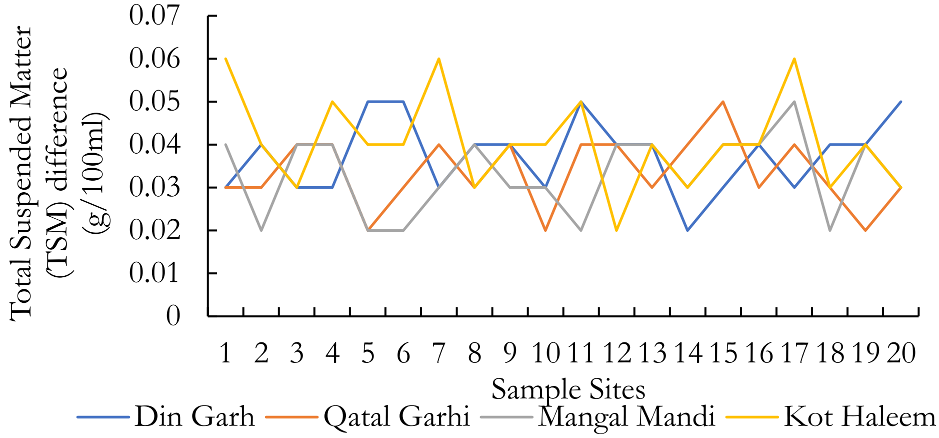

Figure 4. Total Suspended Matter (TSM) difference (g/100ml)

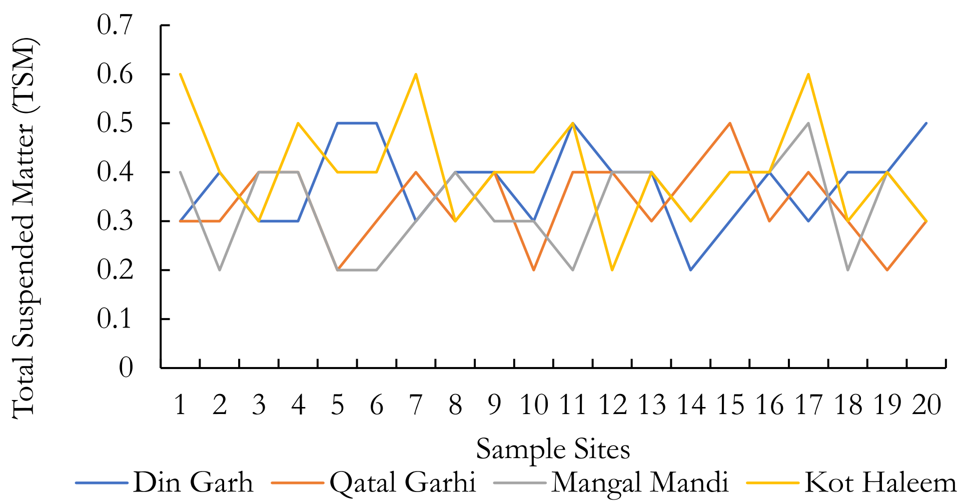

Figure 5. Total Suspended Matter (TSM)

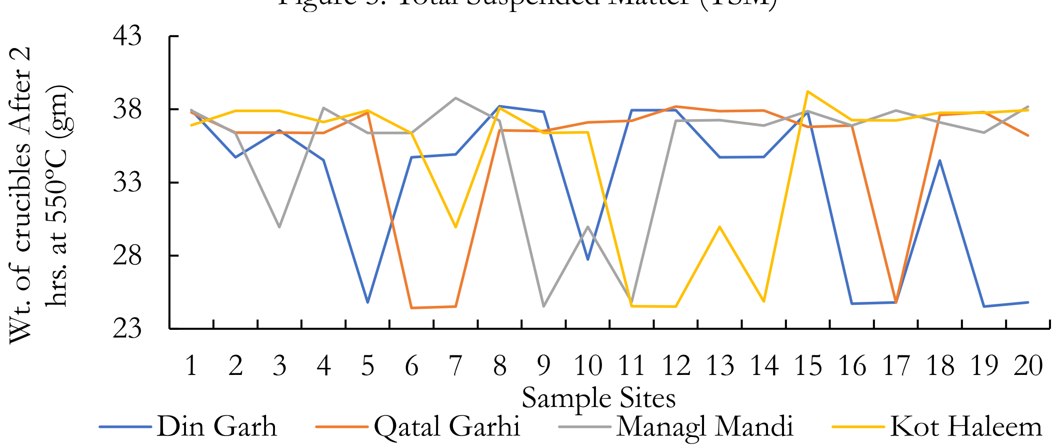

Figure 6. Wt. of crucibles After 2 hrs. at 550°C (gm)

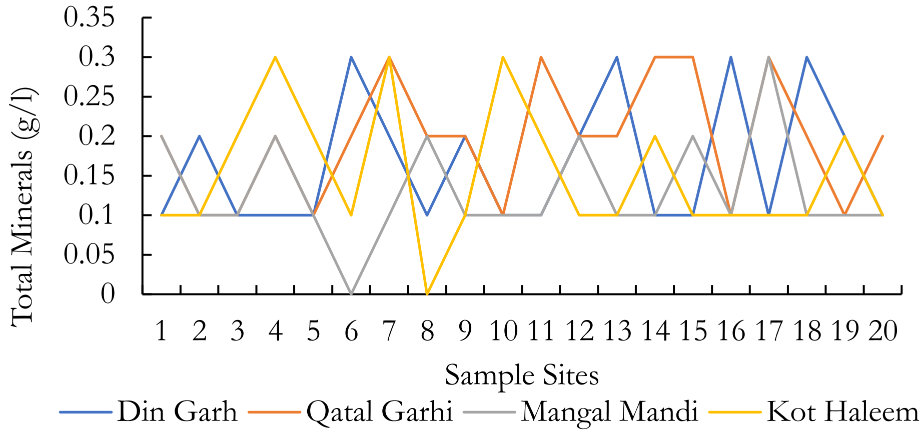

Figure 7. Total minerals (g/l) at various places in the study site.

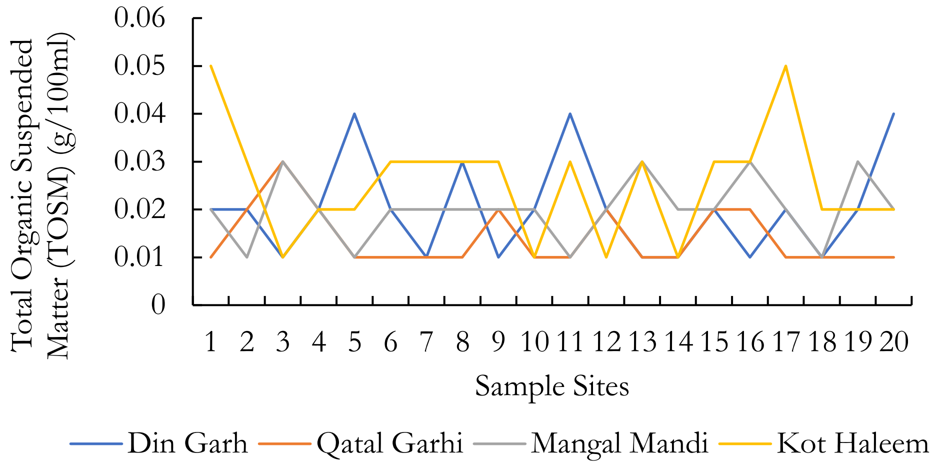

Figure 8. Total Organic Suspended Matter (TOSM) (g/100ml).

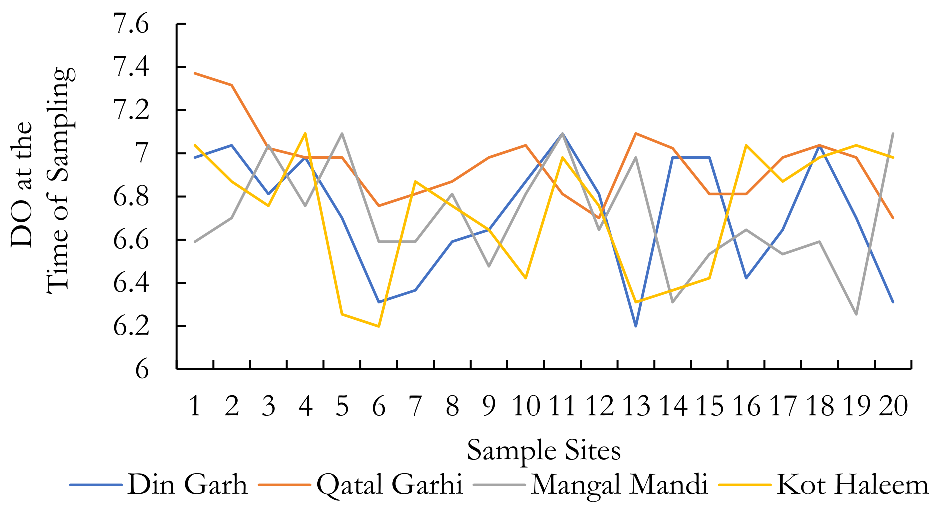

Figure 9. DO at the time of sampling.

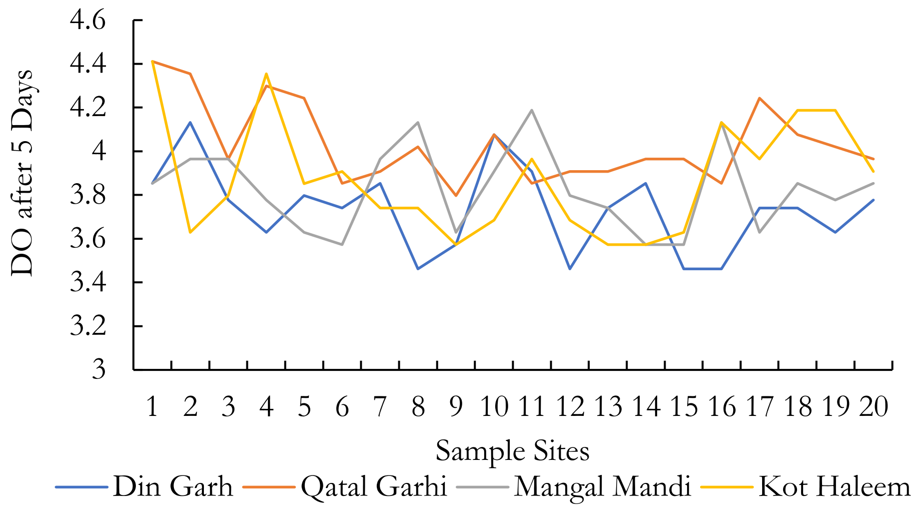

Figure 10. DO after a temporal window of 5 days.

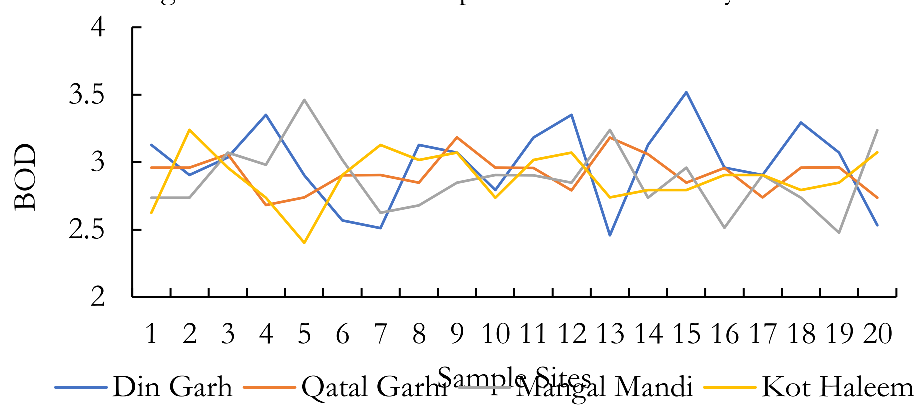

Figure 11. BOD at various sample sites.

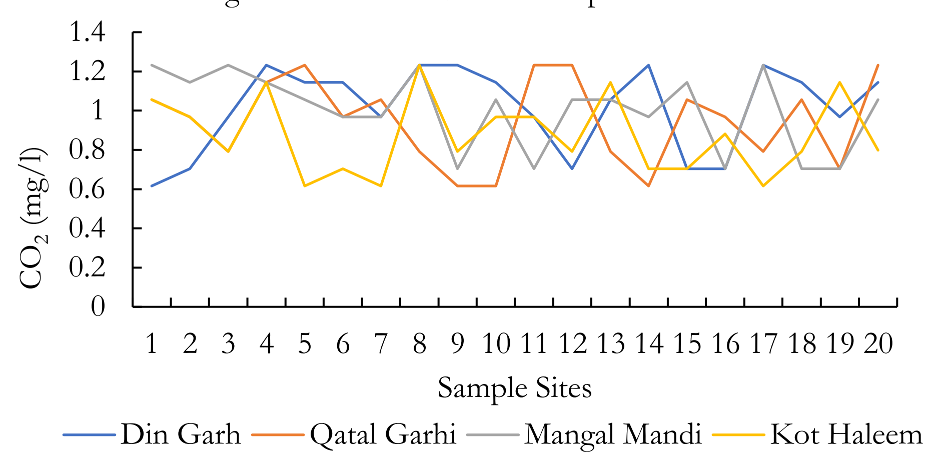

Figure 12. CO_2 (mg/l) at various locations.

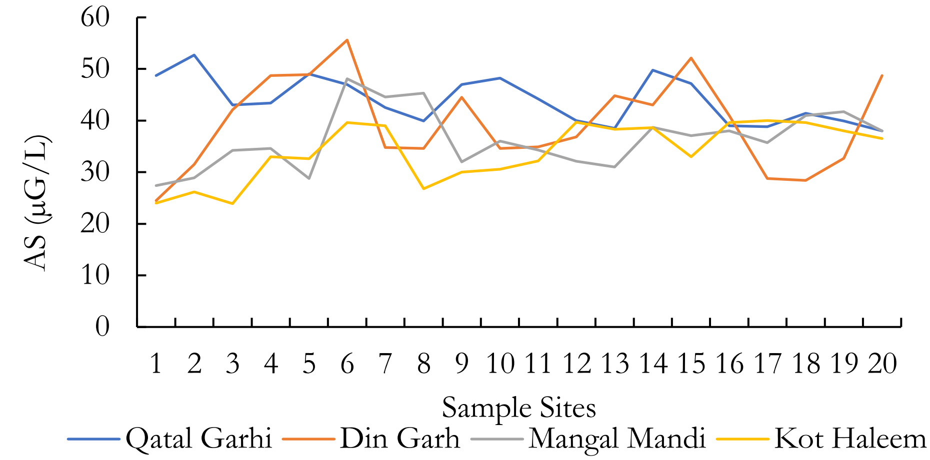

Figure 13. AS (µG/L) at various spatial locations.

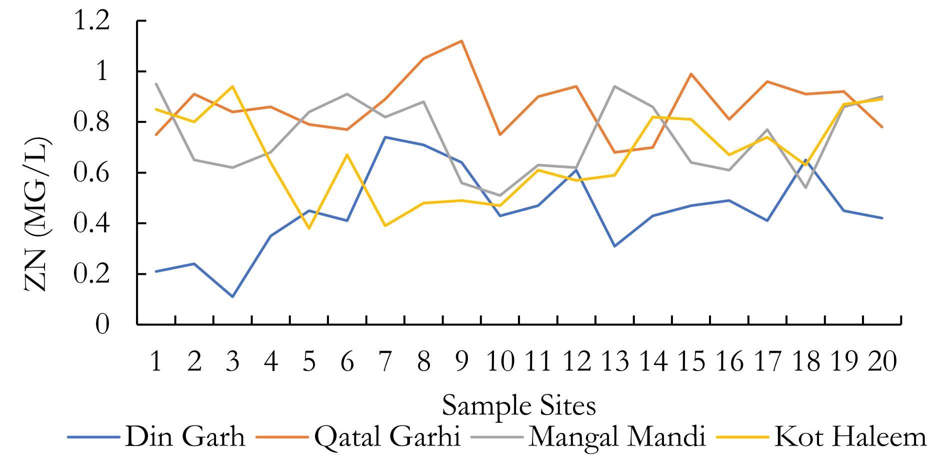

Figure 14. ZN (MG/L) at various spatial locations.

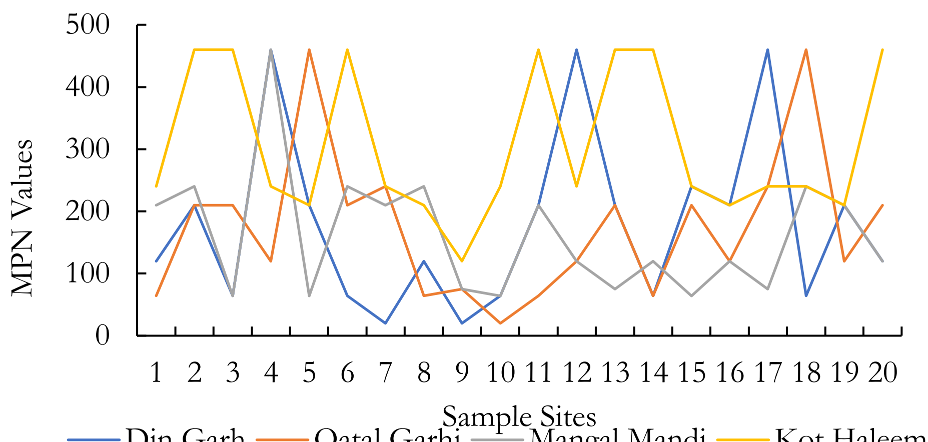

Figure 15. MPN values at various spatial locations.

All the human activities which take part in economic growth, either these are industrial, agrarian, fabric or fashion, these all affect groundwater badly. Current research was conducted in four different residential areas of Kasur. Kasur is an industrial city where physical, chemical and microbiological properties of groundwater had been changed due to anthropogenic activities during recent decade. People use ground water for drinking and for irrigation to their crops. In present study, 80 groundwater samples were collected from four different areas and different parameters (pH, Temperature, BOD, DO, CO_2, TDS, TOSM and Heavy metals) were used to check the physicochemical and bacteriological contamination of groundwater. The physiochemical and bacteriological parameters of ground water were observed changed while making a comparative analysis with previous studies conducted in Kasur. The results show that the ground water of study site was polluted with physiochemical elements like heavy metals. Groundwater temperature was computed using a glass thermometer that ranged from 25-26ºC in DIN GARH area, 23-26ºC in QATAL GARHI area, 25-26ºC in MANGAL MANDI and 25-26ºC in KOT HALEEM KHAN area. The temperature values are within the permissible limits set by National Environment Quality (NEQS) so it can be used for irrigation purpose.

The pH of groundwater ranged between 7.5-7.9 in DIN GHARH, 7.5-8.0 in QATAL GHARI, 7.5-7.8 in MANGAL MANDI and 7.7-8.0 in KOT HALEEM KHAN. The pH of groundwater was observed neutral to alkaline in nature. These values of pH are within limit set by NEQS for pH that is 6-10.

The DO values were measured which were from 6.198-7.036 mg/l in DIN GHARH, 6.254-7.370 mg/l in QATAL GHARHI, 6.757-7.370 mg/l in MANGAL MANDI and 6.199-7.091 mg/l in KOT HALEEM KAN. There was a gradual decrease in DO values when computed after a temporal window of 5 days. The decrease in DO value ranged from 3.573-4.411mg/l in DIN GHARH, 3.573-4.132mg/l in QATAL GHARHI, 3.797-4.355mg/l in MANGAL MANDI and 3.462-4.132mg/l in KOT HALEEM KHAN. The decrease in the DO values after 5 days of respiration for first sampling might be due to elevated level of fecal bacteria. The DO concentration for groundwater ranged from 1.7mg/l-6.7mg/l according to international standards. Dissolved oxygen (DO) is the most important factor in the assessment of water quality. Suitable DO is energetic for aquatic life.

The BOD values of groundwater samples were ranged from 2.458-3.519 mg/l in the study areas. High levels of BOD in study area was due to industrial effluents containing huge amount of organic matter. Biological oxygen demand trials the recyclable materials in water and helps in the growth of bacteria and other organic by-products.

The values for CO_2 were ranged from 0.616-1.144mg/l in DIN GHARH, 0.704-1.232mg/l in QATAL GHARHI, 0.616-1.232mg/l in MANGAL MANDI and 0.616-1.232mg/l in KOT HALEEM KHAN. Unlike oxygen, CO_2 enters into chemical combination with water to form H_2CO_3, which in turn reacts with available limestone to form CO_2 and bicarbonates.

Coliforms were present in high concentration in the complete study site. MPN values ranged from 20 to >1100 in all the groundwater sample sites. When the groundwater samples were processed for the coliform estimation, contaminants were found in all the samples of research areas restricted more than >1100 MPN. In fact, this value is in maximum range as per normal.

Coliform bacteria remain active in human and animal wastes. The bacterial contamination in ground water is studied by coliform test in water drainage system. The presence of coliform bacteria in groundwater indicates the mixing of surface water with ground water. Viruses and bacterial diseases such as typhoid fever, hepatitis, gastrocnemii, dysentery and ear infections can be contracted in water with high fecal coliform counts. World Health Organization (WHO) [67]has justified that the drinkable water must have zero level of coliform and E.coli. In this research it is justified that ground water of Kasur area is contaminated with fecal coliforms.

Regarding the Total Suspended Matter (TSM), the values range from 0.3-0.5g/l in DIN GHARH, 0.2-0.5g/l in QATAL GHARHI, 0.2-0.5g/l in MANGAL MANDI and 0.2-0.6g/l in KOT HALEEM KHAN. The nature of TSPM includes settleable particles, which require more than 6hrs. For the total minerals (TMs), more or less the same pattern was observed. WHO further designates the limit of TDS in drinking water that is 1000 mg/L however, high TDS concentration indicates that various minerals and solids have been dissolved in groundwater. High concentration of TDS governs the remarkable changes in water that effect the taste, hardness and corrosive property of the water. High TDS concentrations are due to the presence of bicarbonates, carbonates, sulphates, chlorides and calcium, which may originate from natural sources, sewage, urban runoff and industrial wastewater.

Total Organic Suspended Matter (TOSM) values of all the groundwater samples were ranged from 0.1-0.4g/l in DIN GHARH, 0.1-0.3g/l in QATAL GHARHI, 0.1-0.3g/l in MANGAL MANDI and 0.1- 0.5g/l in KOT HALEEM KHAN. High concentration of organic carbon states high concentration organic compounds as contaminants.

Atomic Absorption Spectrophotometer was used for the detection of heavy metals which resulted that both, surface and ground water are contaminated with heavy metals. The limits prescribed by WHO for toxic metal production as residual of industries is much lower that is in groundwater available in Pakistan. Both surface and groundwater are sponsors of heavy metals. Many of these metals are important in trace amount of human health. However, in higher amounts they cause water pollution and can be toxic causing serious health issues. Arsenic (As) and Zinc (Zn) are heavy metals which were found in the groundwater of Kasur.

The concentration of As in ground water was observed as 24-52 mg/L. Arsenic concentration vary widely in this groundwater. However, the chronic intake of high arsenic value in groundwater would potentially cause health hazards in future over a long-range period, since this element is reduced into arsenic, which is accumulated in the human body and arsenic is more difficult to remove from drinking water supplies than arsenate. The results show that the value of Zn was ranged from 0.21-0.74 mg/L in DIN GHARH, 0.68-1.12 mg/L in QATAL GHARHI, 0.54-0.95 mg/L in MANGAL MANDI and 0.38-0.94 mg/L in KOT HALEEM KHAN. The chronic drinking of additional Zn in water include severe gastrointestinal effects. Diminished immune function, vicissitudes in lipoprotein and cholesterol levels, abridge copper status and Zinc iron interactions.

CONCLUSION

The study concludes that the water pollution due to tanneries in Kasur have changed the bacteriological and physicochemical properties of ground water to a considerable level. Groundwater was contaminated with high concentrations of BOD, TOSM, TDS, TM and Heavy metals due to discharge of industrial effluents. The continuous release of agricultural runoff, untreated industrial discharges and drainage are the major causes of groundwater pollution in Kasur.

Author's Contribution. All the authors contributed equally.

Conflict of interest. We declare no conflict of interest for publishing this manuscript in IJIST.

Project details. NIL

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Dam Site Identification Using Remote Sensing and GIS (A case study Diamer Basha Dam Site)

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Abstract.
Selection of suitable sites for construction of dam is the most important phase because a number of factors are required to consider that include topography, geology, tectonic settlements and the slope. We selected Diamer Basha dam site to analyze it feasibility considering real-time field data. Geologically the study site is a part of Chilas Mafic Igneous Complex which is not ophiolite. Matic complex is a block which is 40km in depth and 300km in length. These rocks are comparatively hard in nature and are considered good for construction of dam. Tectonically, we observed that the area under investigation was highly active tectonically. Surface deformation rates of the study site are highest throughout the world because this area is comprised of multiple fault lines that include Main Mantle Thurst (MMT), Main Karakoram Thrurst (MKT), Main Boundary Thurst (MBT) and many others. This area has become a hot cake for the geologist worldwide due to it's very high surface deformation rates.Tectonically active regions are considered worst for construction sites, e.g., for dam sites. The dam site is actcually laying on the MKT which is not favorable for construction of Diamir Basha dam. A low-level

earthquake may generate small cracks in concrete structure and any leakage of water may produce big holes with passage of time which are not remidable. A big level earthquake may vanish the dam site completely. Therefore, the current site is not favorable for construction of dam.

Keywords. MMT, MKT, MBT, Suitable sites selection and Geology.

1. Introduction.

Vast areas and agricultural lands are affected by floods that last for many days. The complete infrastructure and ecology are badly disturbed by flood water which may lead to worsen the catastrophic and morphological characteristics of an area. There are many preventives measures which can be taken to avoid after flood situations such as constructions of canals, big drainage systems and dams. Dams are considered the best solution to tackle such accidental events in a better way [1]. Dams and water structures are built to control multiple events such as soil and sedimental erosion, irrigation systems, droughts and mainly for generation of electricity. About 60% of flood water is regulated by reservoirs and dams. There are multiple classes of dams based on engineering point of view such as structural design, hydraulic design and the hydro-electric designs [2].

Hydropower is green energy which is ecofriendly source for many countries [3]. The initial cost of hydro power project is huge and the dams are considered as one of the major sources of hydro power generation. [4]

There are a number of points which must be taken in consideration before dam construction that include valley shape, topography, geological structures, spillway size, roadways, frequency of earthquakes, climate of the dam site, life and height of dam [5]. In all these scenarios, topography, geological structure and frequency of earthquakes are considered most important factors to incorporate before construction of a dam [6].

Topography is the key element that effects all forces which control the overall flow of water into a region [2]. If there is a relief in topography, it will lead to less erosion or incision and vice versa, because a gentle topography does not allow water to move with high pressure resulting in less erosion [7]. Therefore, it is important to compute slop/aspect map to check the nature of topography where a dam is to be constructed [8]. It is recommended that slop must be less than 5% for construction of a dam [9].

Tectonic arrangements underneath a dam site play a vital role in selecting suitable regions to construct a dam [10]. The weightage of a tectonic arrangement is almost very high because the internal forces beneath the earth's surface are strong enough to disturb the complete face of a region within seconds. The regions with high surface deformation rates are discouraged for construction of dams [11].

The size of a catchment area is also considered while constructing a dam. Its size should be within range to feed the dam properly [12]. A very big catchment lead to expensive spillway which is not economical. Hydrological mode of a study site provides drainage points, drainage lines, catchment areas and the overall flow in cusec [13].

GIS has a set of powerful tools known as "Arc Hydro Tools" which provides a watershed model of a study site [14]. Digital Elevation Model (DEM) is commonly used as input to compute the drainage pattern within a study site [15].

Geological settlements of a particular region are important to consider for construction of a dam [16]. Existing geology provides information about available material in a study site. Rocky foundations give high resistance to erosion and incision [17]. Metamorphic rocks bases are hard in nature therefore, these are considered good while constructing a dam [18,19].

The main objective of this research was to analyze the feasibility for construction of Diamer Basha dam while incorporating real-time factors including topography, geology, tectonic arrangement and hydrology of the study site.

Study area.

Diamer-Basha-Dam is a gravity dam which is concrete filled and under construction on Indus river in KPK. This site is located near a place known as Basha which is owned by Water and Power Development Authority (WAPDA). The initial cost of dam was estimated as 14 billion USD in 2013 with height 272m. Projected storage capacity is expected as 1000Mm^3 which will produce 4800 MW electricity upon completion. The diversion system of Diamer-Basha-dam has one canal with two tunnels and spillways having nine gates of size 16.5*15.0m. This dam will affect 31 villages including 4100 households covering a population of 35000 in numbers. An area of 6.1km^2 will be submerged as agricultural land. The area under investigation is mapped in Figure 1, as below.

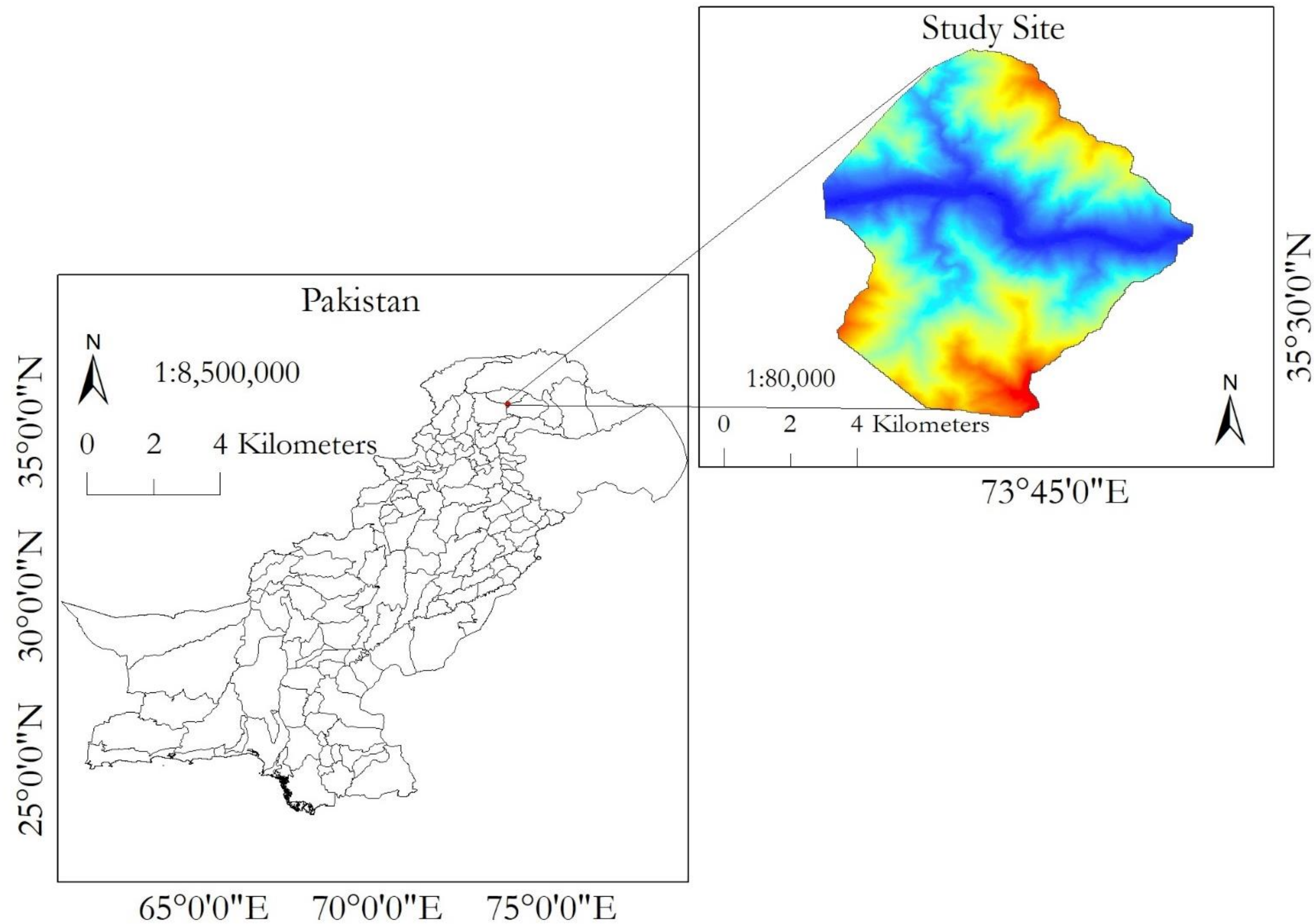

Figure 1. Location of Diamer Basha Dam Site.

Material and Methods

We acquired a DEM of the study site from United State Geological Survey (USGS) website (https://earthexplorer.usgs.gov/) and applied Arc Hydro tools in Arc GIS to draw a watershed model using methodology as shown in Figure 2.

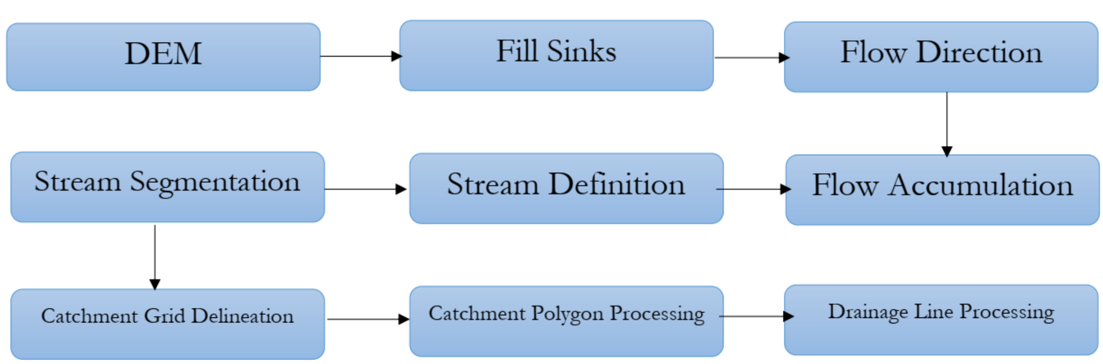

Figure 2. Extraction of drainage network using DEM.

In the first step, sinks were filled and flow direction was computed against each cell. Next, flow was accumulated from each cell to define the stream network. Finally, catchment areas were drawn and the drainage lines were extracted in vector form.

We used DEM to compute slop map of the study site using 3D analyst utility in Arc GIS. The main purpose of this calculation was to evaluate the nature of topography under investigation.

We acquired a map of the study site to investigate the nature of rocks underneath the investigation site. This map was georeferenced and digitized for further processing. We acquire another map of tectonic settlements within or in outskirts of study area. This map was also georeferenced and digitized to draw fault lines existing near to the DAM site.

Result and discussions.

Figure 3 is showing watershed model of the study site which is comprised of a main stream that is Indus river and the joining tributaries against each catchment. The shape of any tributary represents the topographical disturbances in any catchment. If the shape a stream is irregular and non-linear, it represents a very irregular topography. Catchment areas may be termed a sub-basins with unique flow through a water channel flowing toward the main stream. If a stream within a network changes its path suddenly, it represents the existence of a hard rock underneath the earth's surface which forced water to move in different direction. A bend is observed at location A in the study site where Diamer Basha dam is under construction actually which show the presence of hard rock there that was initial requirement for construction of dam.

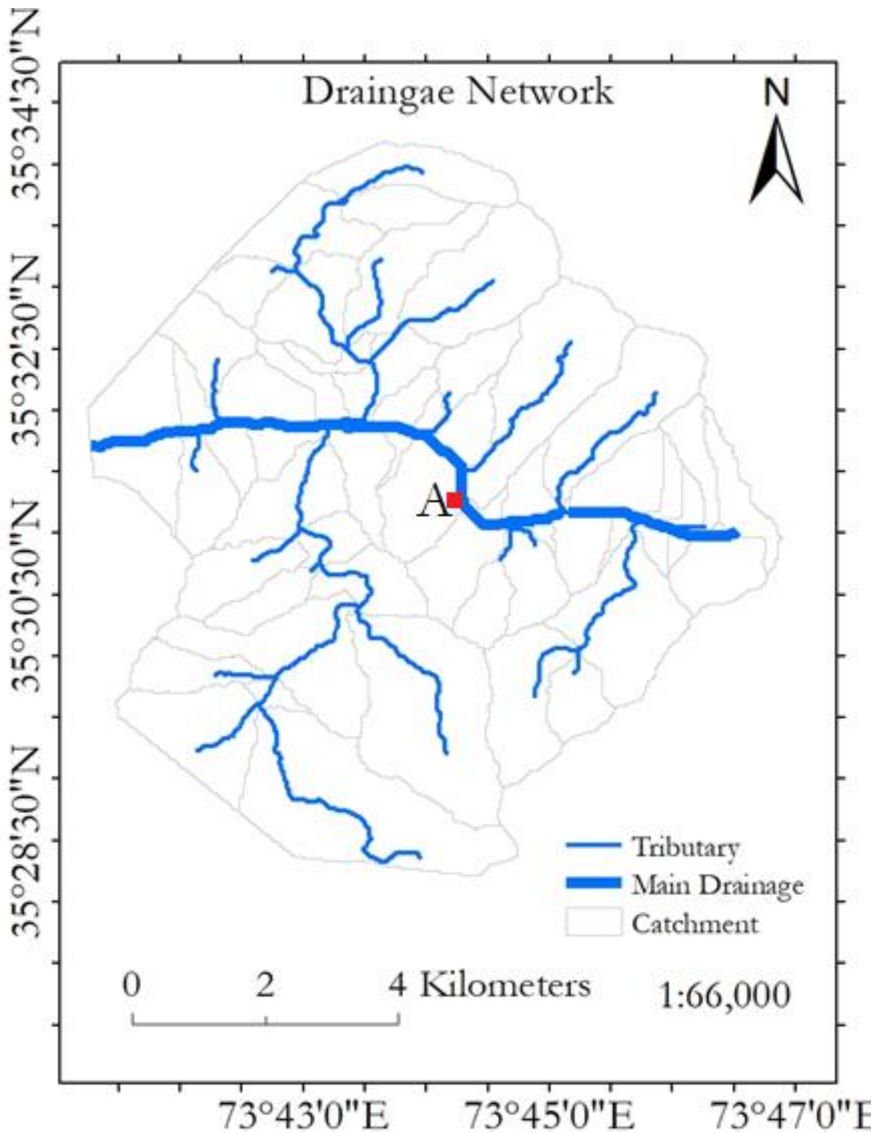

Figure 3. Watershed model of the study site.

Geologically the study site is a part of Chilas Mafic Igneous Complex which is not ophiolite as shown in Figure 4. Matic complex is a block which is 40km in depth and 300km long that is comprised of plagioclase, orthopyroxenc, clino pyroxenc ilmenite, magnetite, flood spar, quartz, hornblende, scapolite and biotite. The rocks of this complex are petrographic which resemble with plutonic blocks. These rocks are comparatively hard in nature and are considered good for construction of dam. Therefore, this area is suitable dam sites.

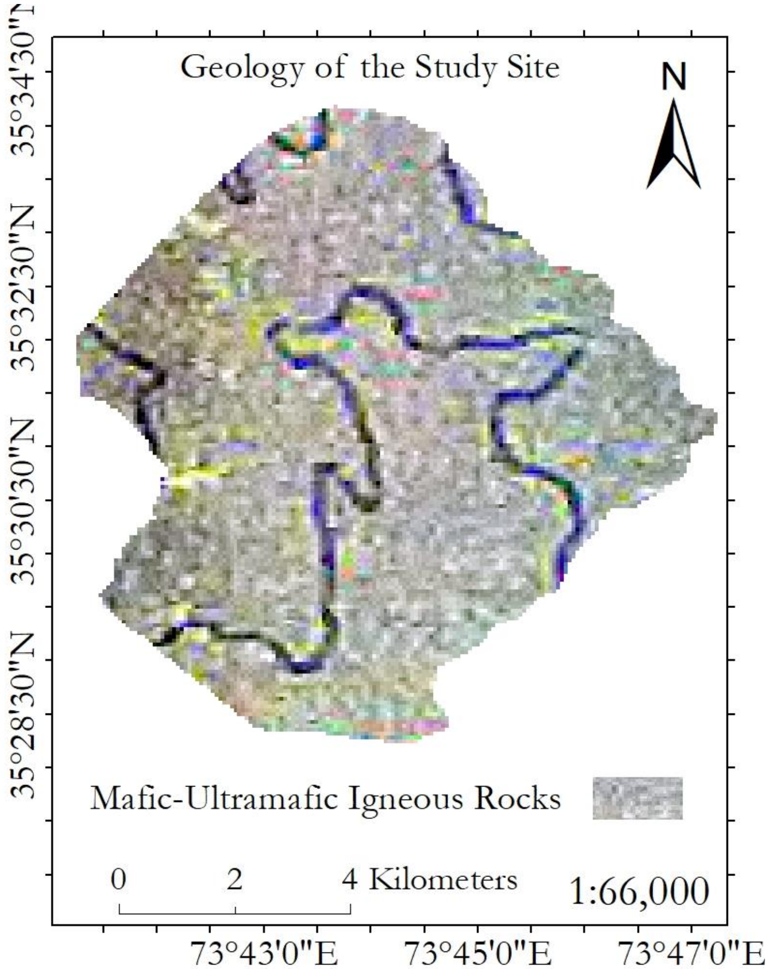

Figure 4. Geology of the study site.

Dams require gentle slops because gentle slop offer less erosion/incision and finally less amount of sedimentation. The slop map of the study site represent a percentage slop as shown in Figure 5. Overall slope of study site is greater than 5% which is not favorable for construction of dam. The areas highlighted with red color in Figure 5 have high slopes in comparison to blue areas. The areas adjoing to Indus river were found having gentle slops while the far topography was observed steeper. In context of slop, the study site is not suitable for construction of a dam because a big flow of rainy water from Gilgit may exert enough pressure that can vanish the dam completely.

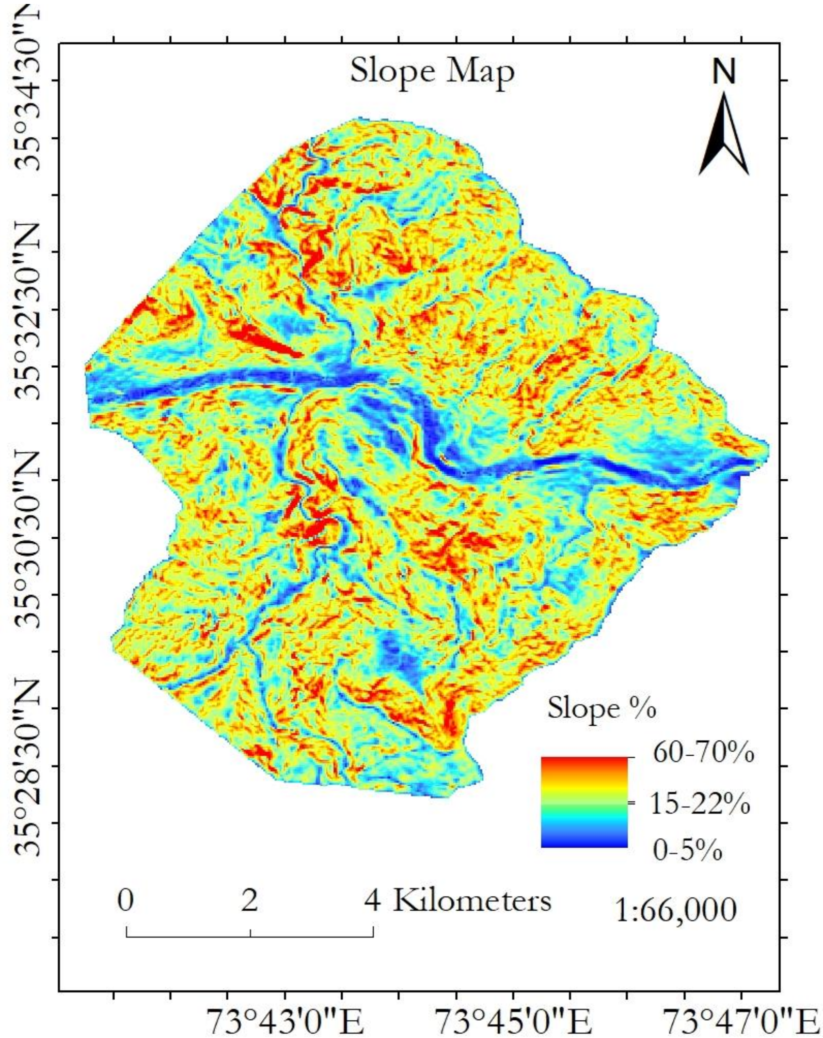

Figure 5. Slope map of the study site.

Tectonic activity underneath a construction site is indeed the most important factor which must not be ignored for the success of a project. We observed that the area under investigation was highly active tectonically. Surface deformation rates of the study site are highest throughout the world because this area is comprised of multiple fault lines that include Main Mantle Thurst (MMT), Main Karakoram Thrurst (MKT), Main Boundary Thurst (MBT) and many others. This area has become a hot cake for the geologist worldwide due to it's very high surface deformation rates.

Tectonically active regions are considered worst for construction sites, e.g., for dam sites. Figure 6 is showing that dam site is actcually laying on the MKT which is not favorable for construction of Diamir Basha dam. A low-level earthquake may generate small cracks in concrete structure and any leakage of water may produce big holes with passage of time which are not remidable. A big level earthquake may vanish the dam site completely. Therefore, the current site is not favorable for construction of dam.

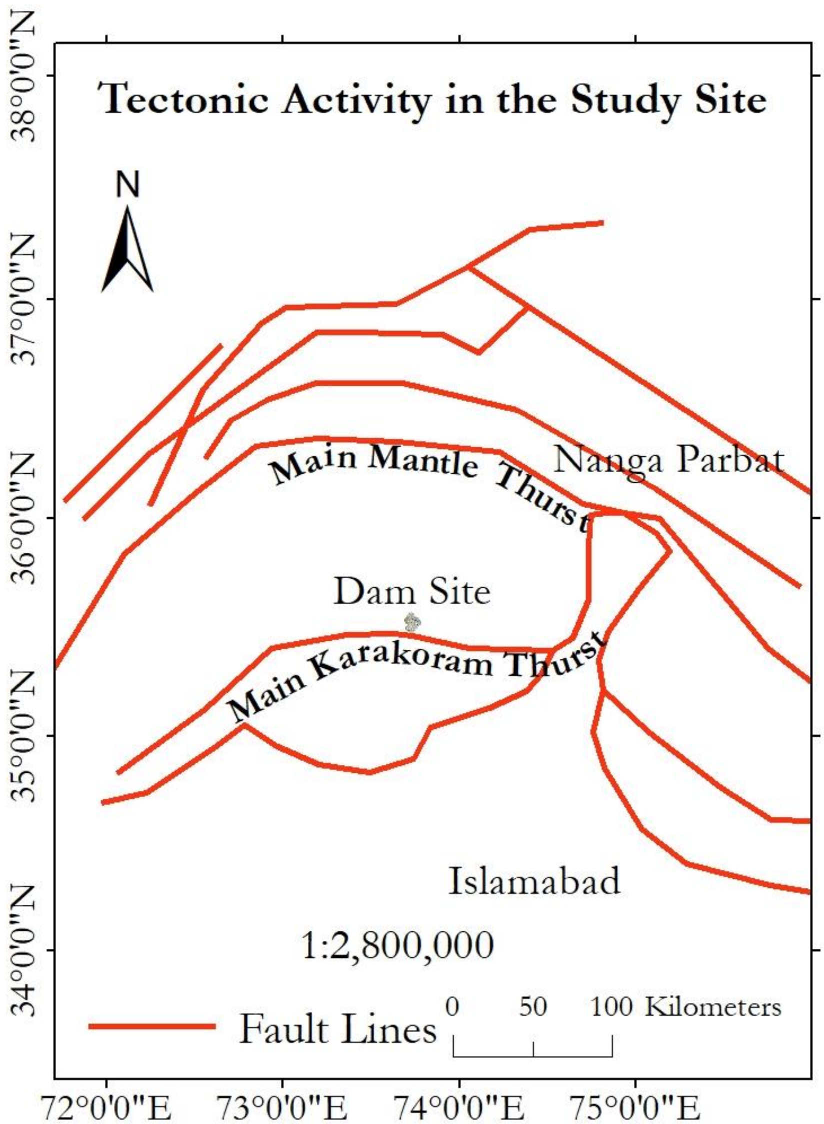

Figure 6. Tectonic arrangements in the study site.

Conclusions.

The study site is surrounded by a number of highly active fault lines. The surface deformation rates within this region, are recorded highest throughout the world. Such tectonically active regions are not favorable for construction sites in any scenario. Although other factors such as topography, slope and drainage pattern are in favor of construction of dam but the weightage of tectonic arrangement supersede all these factors and does not allow this site for construction of dam.

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Author's Contribution. All the authors contributed equally.

Conflict of interest. We declare no conflict of interest for publishing this manuscript in IJIST.

Project details. NIL

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