

Physicochemical and microbiological characteristics of Ras El-Ain basin, Tyr, Lebanon

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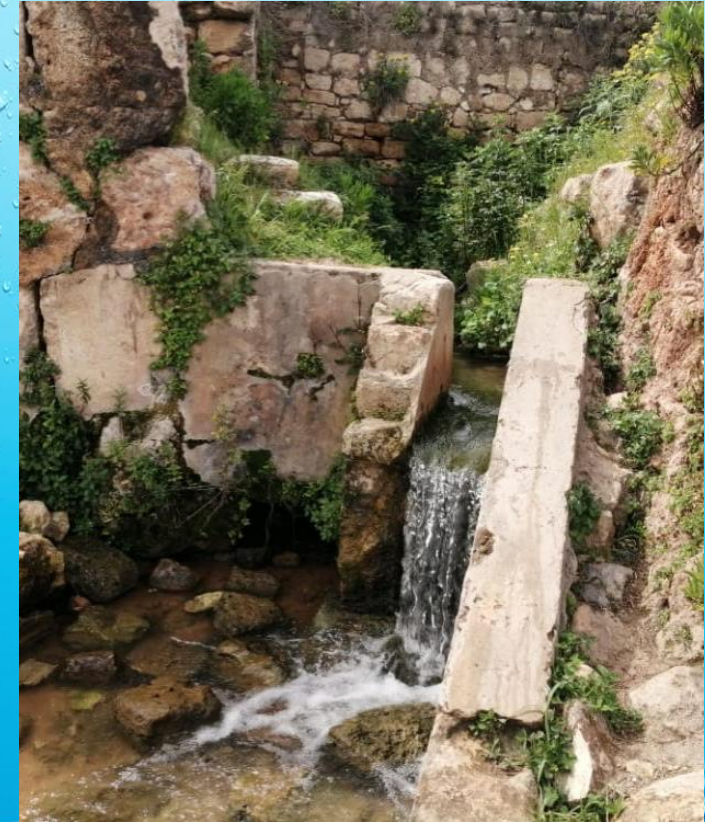
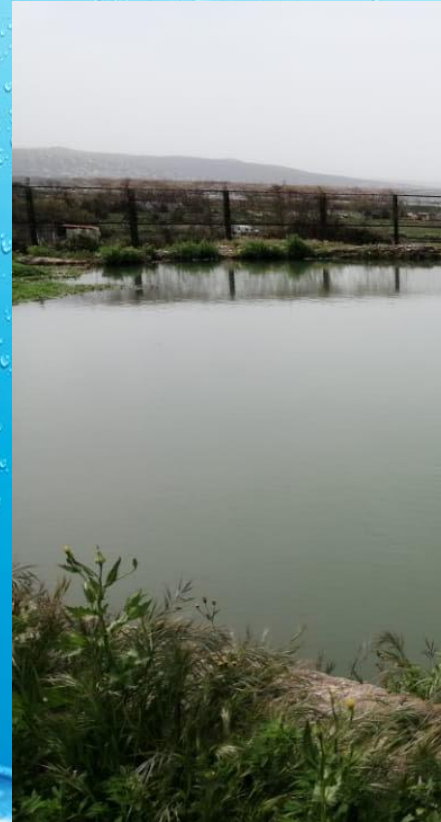
December 7, 2022

Abstract

Lebanon's natural water resources are facing serious problems and approaches exhaustion. One of these issues is deteriorating performance, which is linked to unregulated resource planning and rising demand. There are many different types of consumption, such as residential, industrial, and irrigation. Surface and groundwater are both referred to designate water resources. However, due to the obvious accessibility of exploitation, surface water resources such as rivers, lakes, and basins are primarily used. The Ras El-Ain basin is 6 km far south of Tyr, Lebanon. The Lebanese state dedicated it, along with other reservoirs, to supply potable water for Tyr and the surrounding villages. Today, these basins' water quality has deteriorated significantly because of unrestricted liquid and soil waste dumping. As a result, contaminants develop in the basin water. Aside from laboratory testing for water quality, contamination can be seen through direct observations, odors, watercolors, and patterns. The purpose of this study is to assess the level of pollution in the Ras El-Ain basin. This basin has been progressively subjected to a variety of quality degradation characteristics. This includes the most important physiochemical properties. As a result, the physicochemical and microbiological water characteristics of five selected samples from each basin were tested. These tests were performed in accordance with European Standard Methods and World Health Organization guidelines (WHO). The effect of pollutant disposal in the Ras El-Ain basin was studied using multivariate approaches. The obtained results were used to evaluate the pollution degree in various regions of the basin.

2022 The 5th International Symposium on Water Pollution and Treatment

 **ISWPT 2022**
October 28-29, 2022 Bangkok



 **Physicochemical and
microbiological
characteristics of Ras El-
Ain basin, Tyre, Lebanon**

Oct. 28-29, 2022 | Webinar

Physicochemical and microbiological characteristics of Ras El-Ain basin, Tyre, Lebanon



Dr. Milad Khatib
ISSEA-Cnam, Lebanon

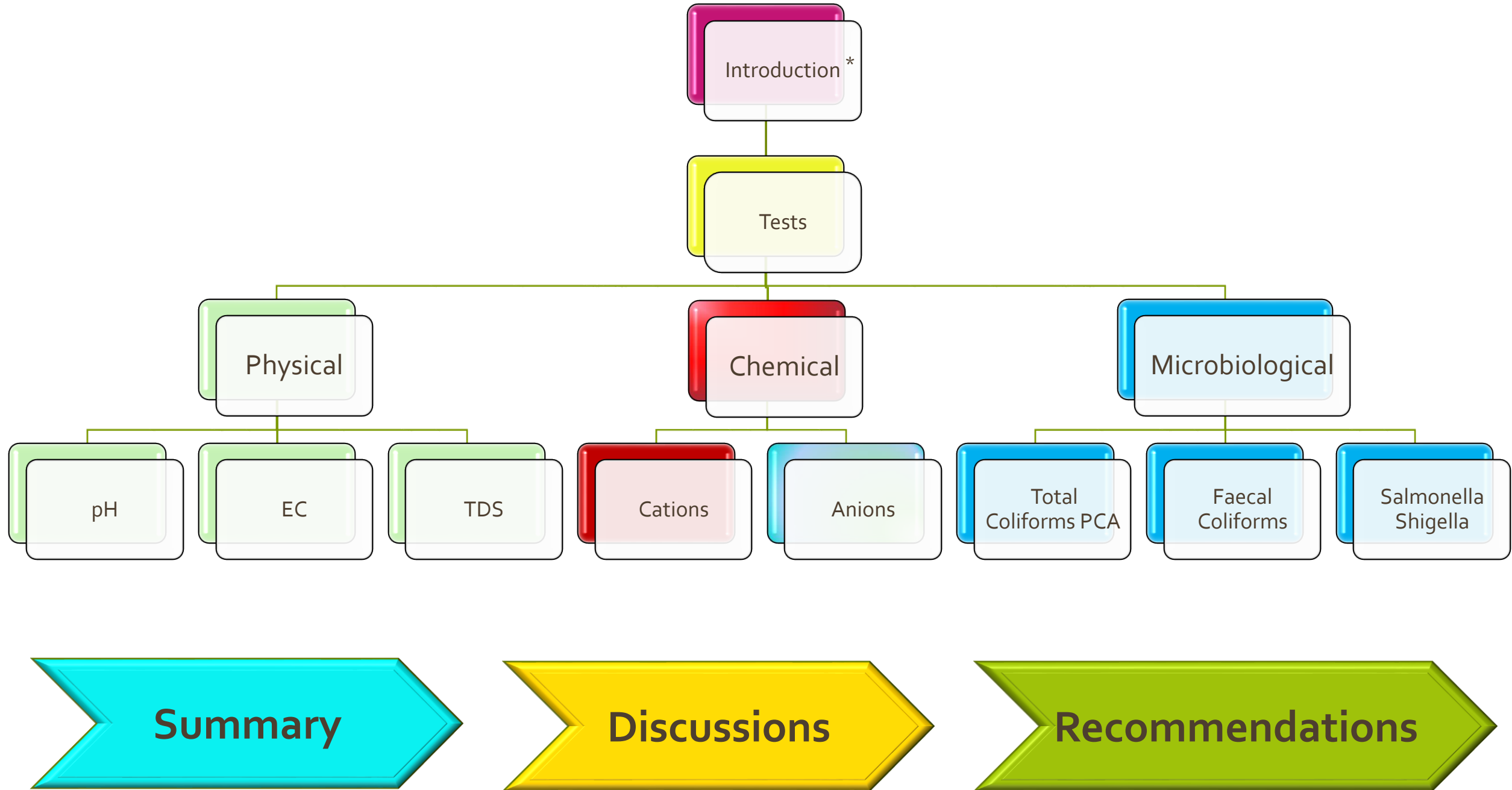
Ass. Prof. Wahib Arairo
University of Balamand



Mbio. Mohamad Daoud
Lebanese University

Prof. Hussein Mortada
Lebanese University





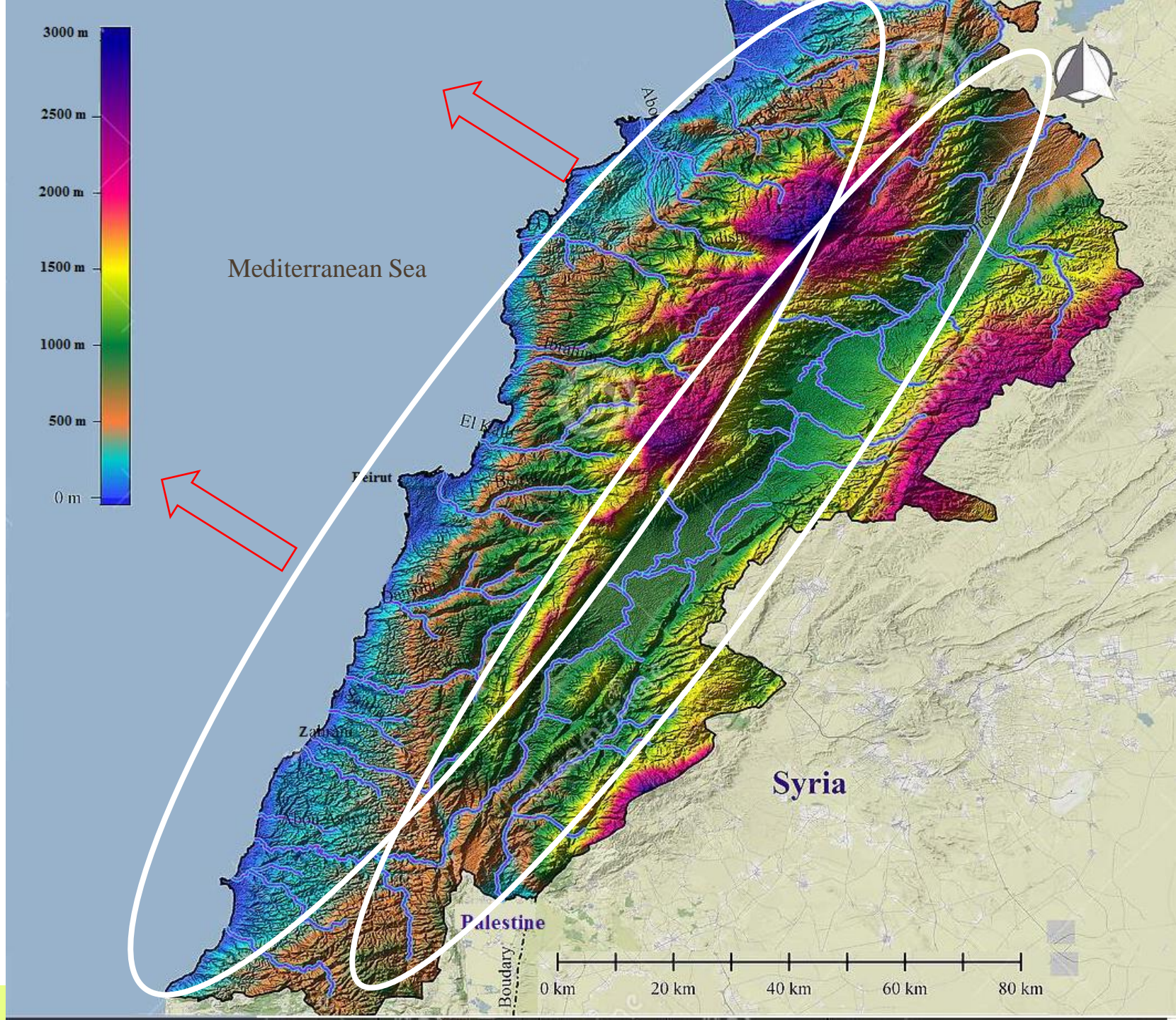
Chamouni Reda..@AncienCity..Puits de Salomon Tyr sud Liban 1714
برك رأس العين صور جنوب (لبنان)



*
**Ras
El-Ain
Basin
1714**

Introduction

- All Lebanon rivers are non navigable.
- 28 begin on the western slope of the Lebanon range and flow via steep gorges into the Mediterranean Sea.
- Besides that, there are six rivers originate in the Beqaa Valley.



Abou Ali River

Ibrahim River

Lebanon's
natural
water
resources
are facing
serious
problems
and
approach
from
Exhaustion^{*}

Beirut River

Awali River



Lebanon's
natural
water
resources
are facing
serious
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from
Exhaustion^{*}



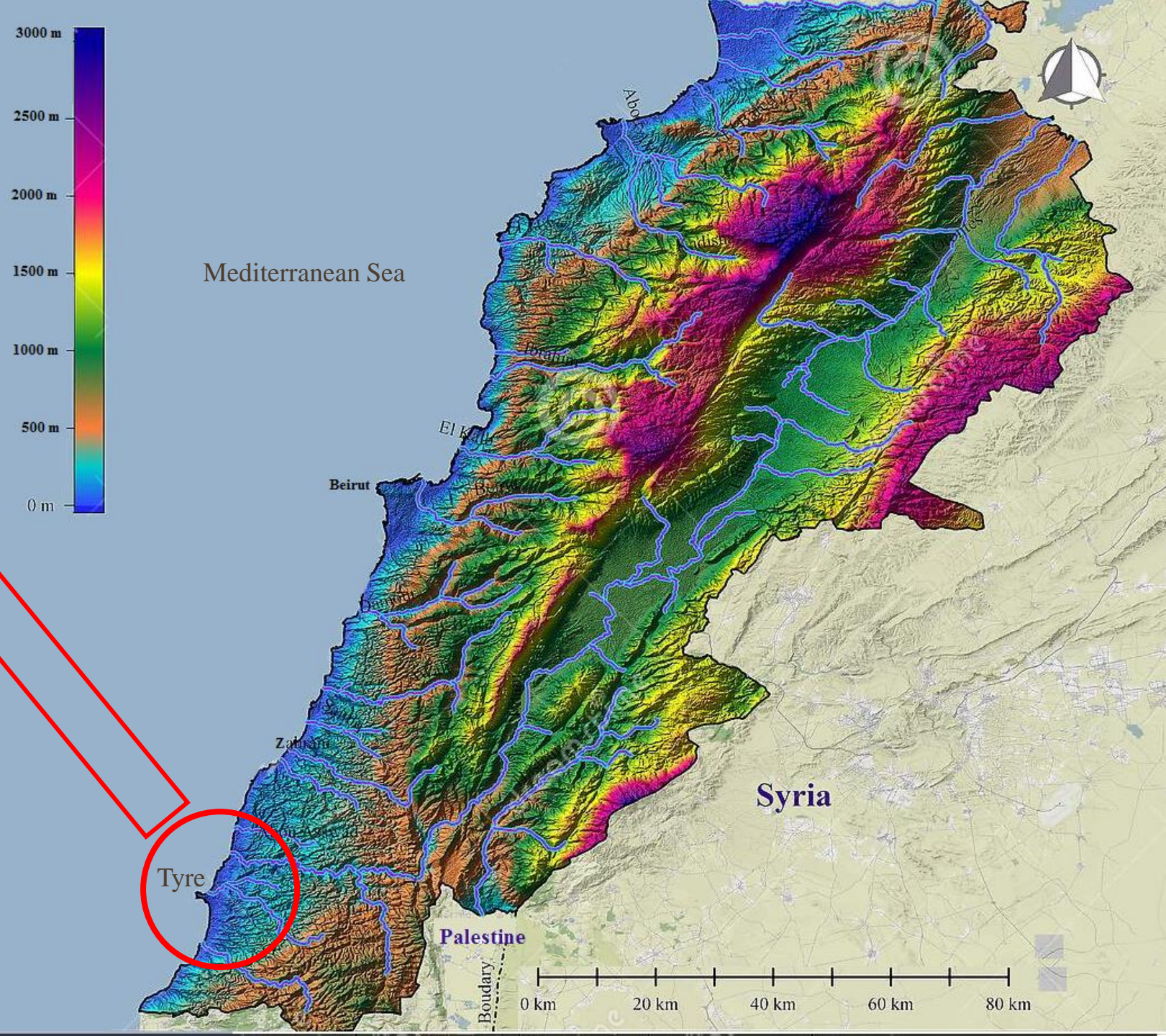


Lebanon's
natural
water
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are facing
serious
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from
Exhaustion*

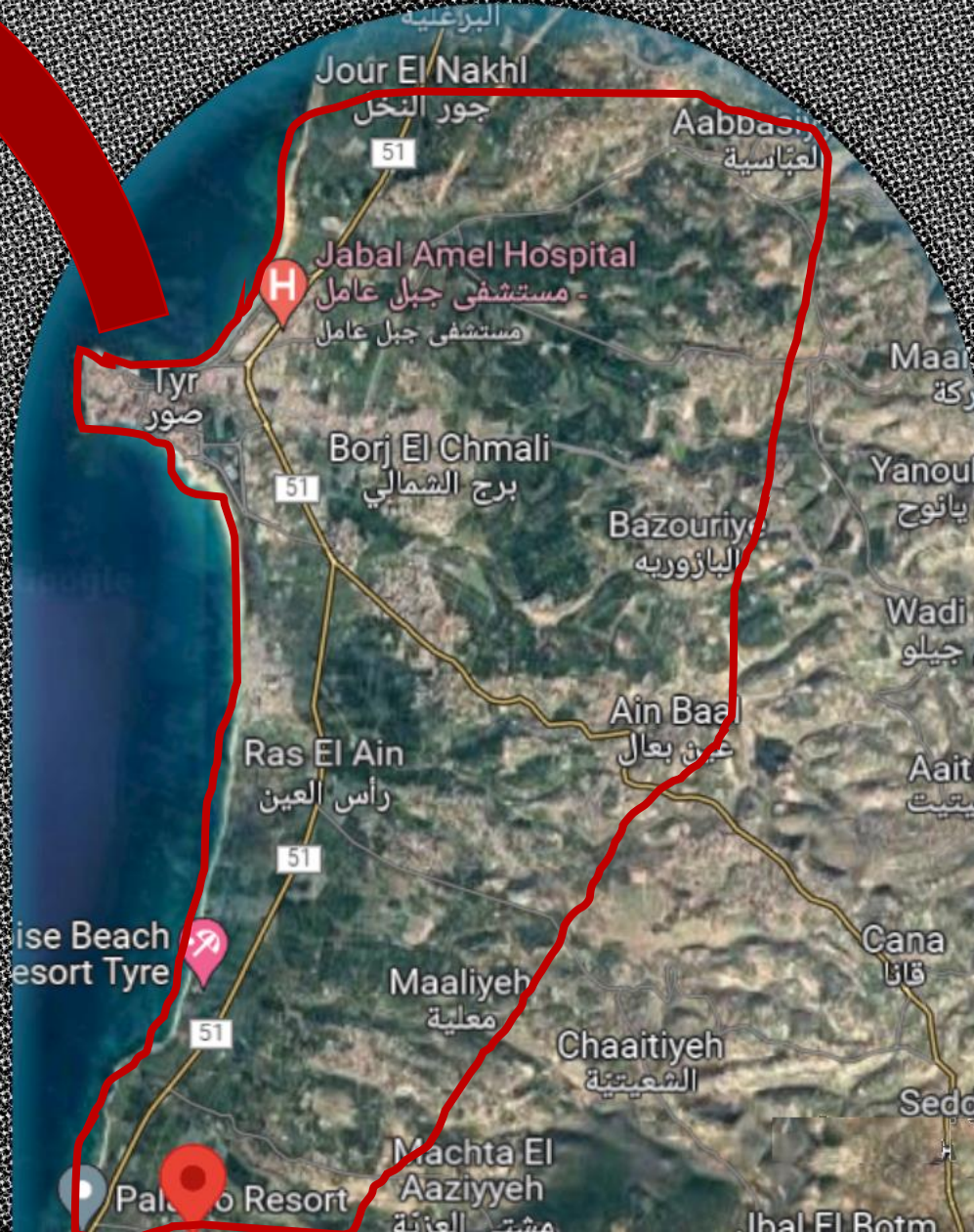




- * The Ras El-Ain basin is 6 km far south of Tyre, Lebanon.



over
30 km square.



The Lebanese
state dedicated
it, along with
other reservoirs,
to supply
potable water
for:

Tyr
&
Surrounding
villages.

Observations



These basins' water quality has deteriorated significantly.

Contamination can be seen through direct observations, odors, watercolor, and patterns.



Ras El-Ain Basin Location



Different selected samples from each basin were tested.

| Name | Designation |
|---------------------|-------------|
| Al-Safsafa Stagnant | SF1 |
| Al-Safsafa Tide | SF2 |
| Al-Sayde | SD |
| Al-Asrawi | SA |
| Water Department | MS |

To assess the level of pollution in the Ras El-Ain basin “physicochemical and microbiological”

Physical Tests

Microprocessor pH

To test the degree of acidity or alkalinity for the water

Tracer EC/TDS

To measure the water's capacity into carrying Electric Current

To measure the Total Dissolved matter in the water

Physical Tests

Microprocessor pH

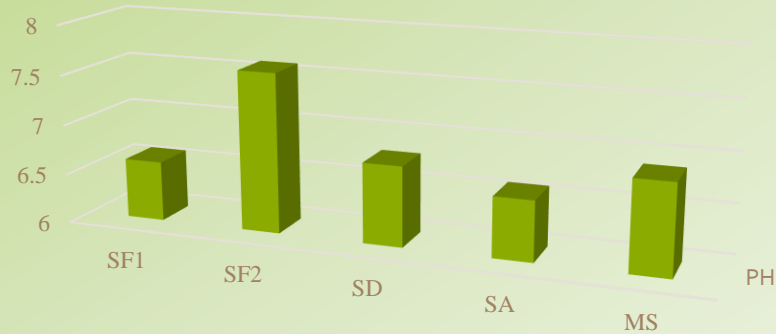


Tracer EC/TDS

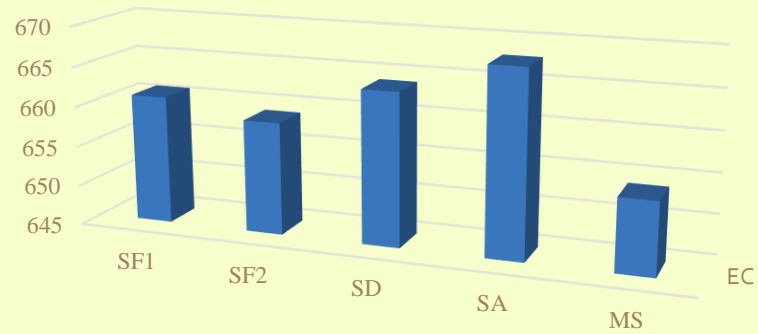


Physical Tests

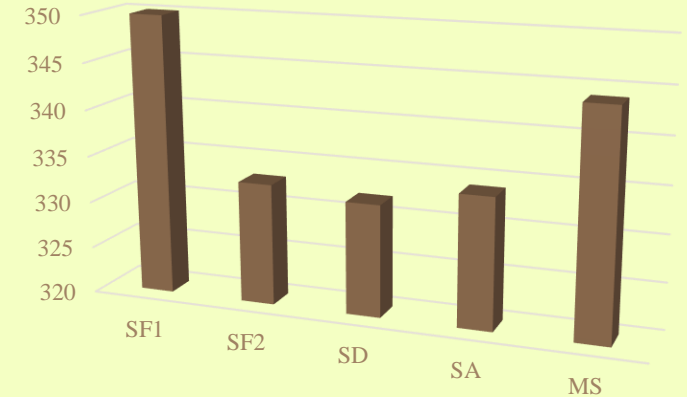
pH



EC



TDS



LIBNOR (Lebanese Standard Institution) specifications

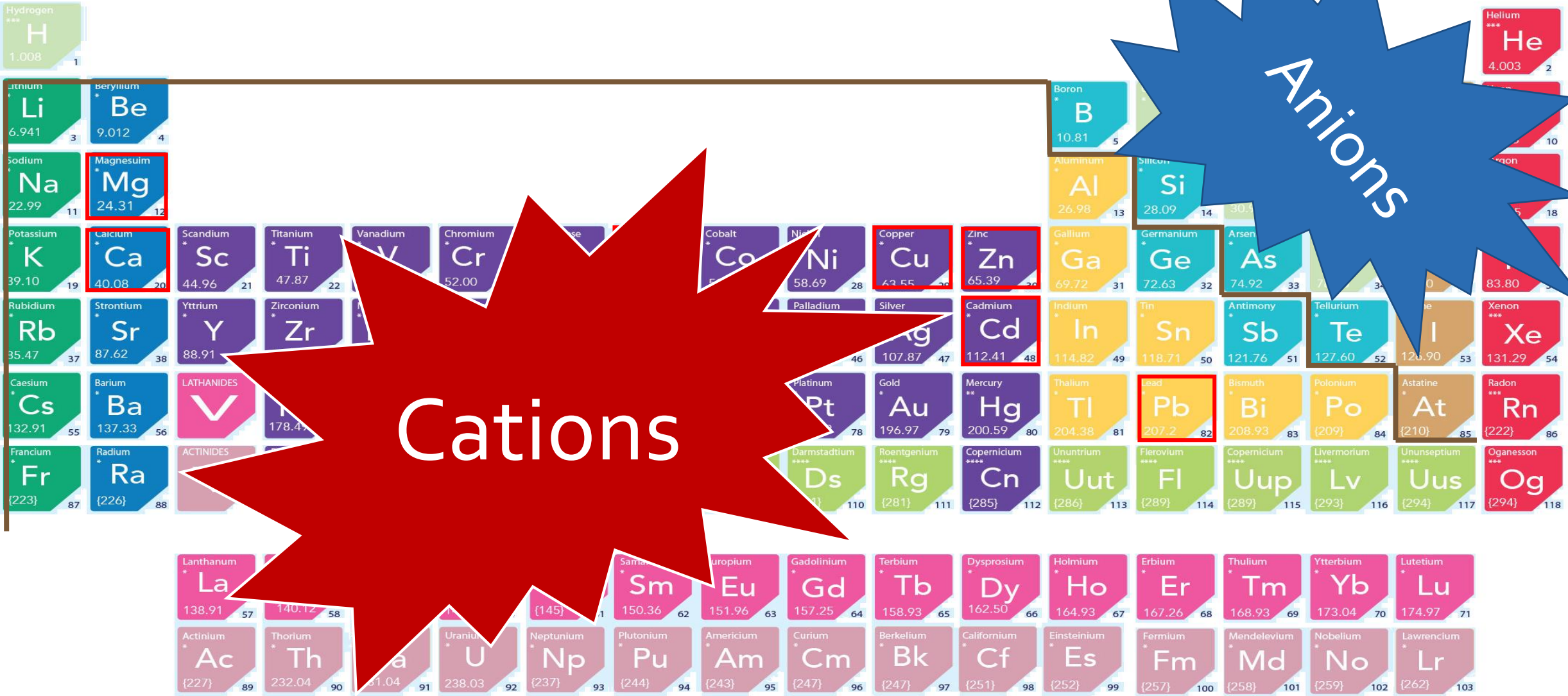
$6.5 < \text{pH} < 8.5$

$\text{EC} < 1500 \mu\text{S}/\text{cm}$

$< 500 \text{mg}/\text{L}$

Chemical Tests

Cations: Ca, Cd, Cu, Fe, Mg, Pb, and Zn



Flame Atomic Absorption (FAAS)

Cadmium

Non Detected

< 0.005mg/L

Lead

Non Detected

< 0.1mg/L



Flame Atomic Absorption (FAAS)

Cadmium

Non Detected

< 0.005mg/L

Lead

Non Detected

< 0.1mg/L

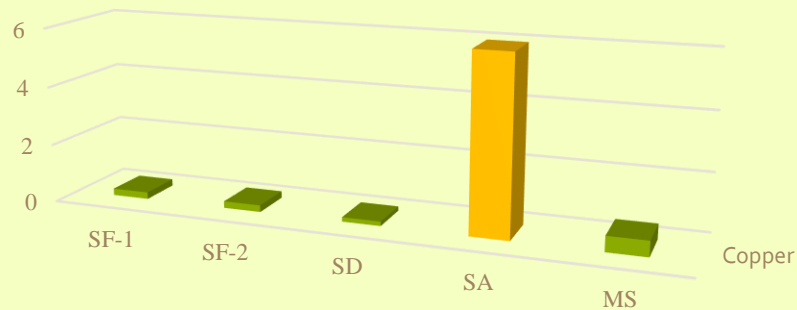
It is a popular method for identifying metals in natural materials. This principle is based on measuring the intensity of emitted light when metal is put into the flame. The wavelengths of the color indicate the element, and the color of the flame represents the amount of the contained item.

Calcium



< 200mg/L

Copper



< 1mg/L

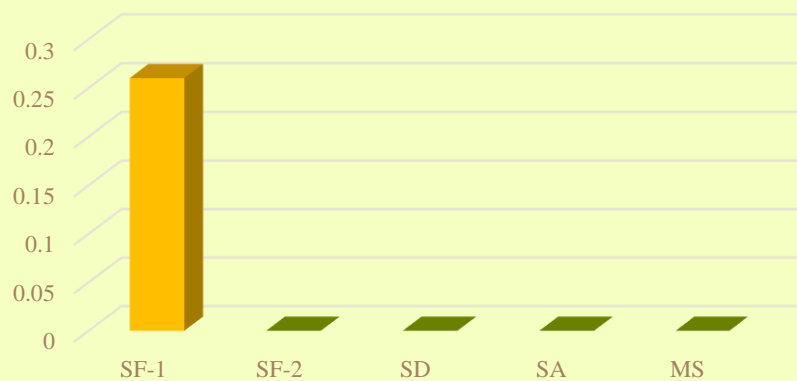
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Iron



< 0.3mg/L

Lead



< 0.1mg/L

Magnesium

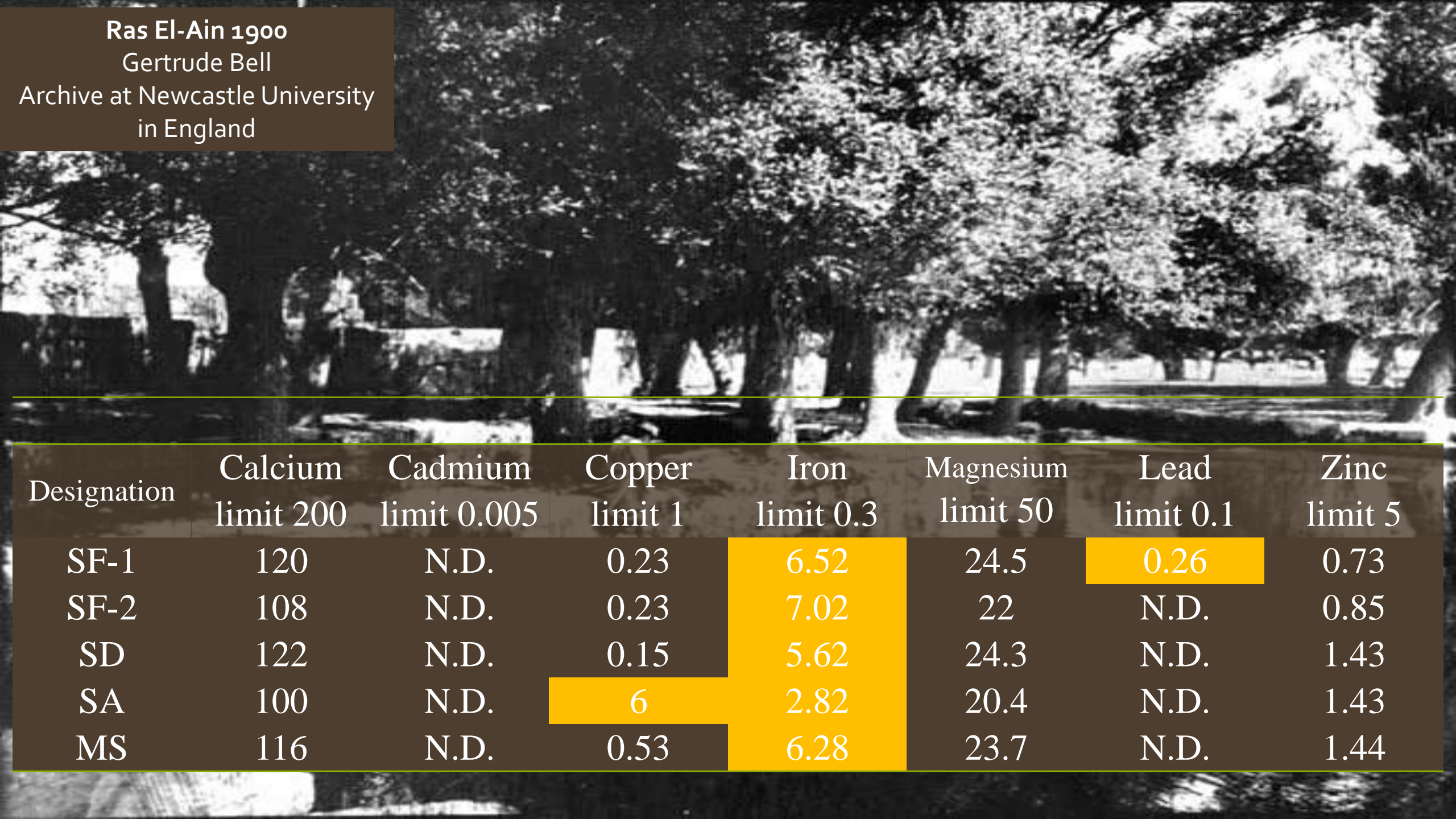


< 50mg/L

Zinc



< 5mg/L



Ras El-Ain 1900
Gertrude Bell
Archive at Newcastle University
in England

| Designation | Calcium limit 200 | Cadmium limit 0.005 | Copper limit 1 | Iron limit 0.3 | Magnesium limit 50 | Lead limit 0.1 | Zinc limit 5 |
|-------------|----------------------|------------------------|-------------------|-------------------|-----------------------|-------------------|-----------------|
| SF-1 | 120 | N.D. | 0.23 | 6.52 | 24.5 | 0.26 | 0.73 |
| SF-2 | 108 | N.D. | 0.23 | 7.02 | 22 | N.D. | 0.85 |
| SD | 122 | N.D. | 0.15 | 5.62 | 24.3 | N.D. | 1.43 |
| SA | 100 | N.D. | 6 | 2.82 | 20.4 | N.D. | 1.43 |
| MS | 116 | N.D. | 0.53 | 6.28 | 23.7 | N.D. | 1.44 |

Chemical Tests *

Anions: Br, Cl, F, NO₂, NO₃, PO₄, and SO₄

| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--------------------------------------|--|-------------------------------------|--|---|--|---|--|--------------------------------------|--|--|--|---------------------------------------|--|---------------------------------------|--|--|--|--|--|---|--|---|--|--|--|---|--|--|--|---|--|--|--|--|--|
| Hydrogen *** H 1.008 1 | | | | | | | | | | | | | | | | | | Helium *** He 4.003 2 | | | | | | | | | | | | | | | | | |
| Lithium * Li 6.941 3 | | Beryllium * Be 9.012 4 | | | | | | | | | | | | | | | | | | Boron * B 10.81 5 | | Carbon * C 12.01 6 | | Nitrogen *** N 14.01 7 | | Oxygen *** O 16.00 8 | | Flourine *** F 18.998 9 | | Neon *** Ne 20.18 10 | | | | | |
| Sodium * Na 22.99 11 | | Magnesium * Mg 24.31 12 | | | | | | | | | | | | | | | | | | Aluminum * Al 26.98 13 | | Silicon * Si 28.09 14 | | Phosphorus * P 30.97 15 | | Sulphur * S 32.07 16 | | Chlorine *** Cl 35.45 17 | | Argon *** Ar 39.95 18 | | | | | |
| Potassium * K 39.10 19 | | Calcium * Ca 40.08 20 | | Scandium * Sc 44.96 21 | | Titanium * Ti 47.87 22 | | Vanadium * V 50.94 23 | | Chromium * Cr 52.00 24 | | Maganese * Mn 54.94 25 | | Iron * Fe 55.84 26 | | Cobalt * Co 58.93 27 | | Nickel * Ni 58.69 28 | | Copper * Cu 63.55 29 | | Zinc * Zn 65.39 30 | | Gallium * Ga 69.72 31 | | Germanium * Ge 72.63 32 | | Arsenic * As 74.92 33 | | Selenium * Se 78.96 34 | | Bromine ** Br 79.90 35 | | Krypton *** Kr 83.80 36 | |
| Rubidium * Rb 85.47 37 | | Strontium * Sr 87.62 38 | | Yttrium * Y 88.91 39 | | Zirconium * Zr 91.22 40 | | Niobium * Nb 92.91 41 | | Molybdenum * Mo 95.94 42 | | Technetium * Tc {98} 43 | | Ruthenium * Ru 101.07 44 | | Rhodium * Rh 102.91 45 | | Palladium * Pd 106.42 46 | | Silver * Ag 107.87 47 | | Cadmium * Cd 112.41 48 | | Indium * In 114.82 49 | | Tin * Sn 118.71 50 | | Antimony * Sb 121.76 51 | | Tellurium * Te 127.60 52 | | Iodine * I 126.90 53 | | Xenon *** Xe 131.29 54 | |
| Caesium * Cs 132.91 55 | | Barium * Ba 137.33 56 | | LATHANIDES * V 57-71 | | Hafnium * Hf 178.49 72 | | Tantalum * Ta 180.95 73 | | Tungsten * W 183.84 74 | | Rhenium * Re 186.21 75 | | Osmium * Os 190.23 76 | | Iridium * Ir 192.22 77 | | Platinum * Pt 195.08 78 | | Gold * Au 196.97 79 | | Mercury ** Hg 200.59 80 | | Thallium * Tl 204.38 81 | | Lead * Pb 207.2 82 | | Bismuth * Bi 208.93 83 | | Polonium * Po {209} 84 | | Astatine * At {210} 85 | | Radon *** Rn {222} 86 | |
| Francium * Fr {223} 87 | | Radium * Ra {226} 88 | | ACTINIDES * V 89-103 | | Rutherfordium **** Rf {267} 104 | | Dubnium *** Db {268} 105 | | Seaborgium **** Sg {269} 106 | | Bohrium **** Bh {270} 107 | | Hassium **** Hs {269} 108 | | Meitnerium **** Mt {278} 109 | | Darmstadtium **** Ds {281} 110 | | Roentgenium **** Rg {281} 111 | | Copernicium **** Cn {285} 112 | | Ununtrium **** Uut {286} 113 | | Flerovium **** Fl {289} 114 | | Copernicium **** Uup {289} 115 | | Livermorium **** Lv {293} 116 | | Ununseptium **** Uus {294} 117 | | Oganesson *** Og {294} 118 | |
| Lanthanum * La 138.91 57 | | Cerium * Ce 140.12 58 | | Prasodymium * Pr 140.91 59 | | Neodymium * Nd 144.24 60 | | Promethium * Pm {145} 61 | | Samarium * Sm 150.36 62 | | Europium * Eu 151.96 63 | | Gadolinium * Gd 157.25 64 | | Terbium * Tb 158.93 65 | | Dysprosium * Dy 162.50 66 | | Holmium * Ho 164.93 67 | | Erbium * Er 167.26 68 | | Thulium * Tm 168.93 69 | | Ytterbium * Yb 173.04 70 | | Lutetium * Lu 174.97 71 | | | | | | | |
| Actinium * Ac {227} 89 | | Thorium * Th 232.04 90 | | Protactinium * Pa 231.04 91 | | Uranium * U 238.03 92 | | Neptunium * Np {237} 93 | | Plutonium * Pu {244} 94 | | Americium * Am {243} 95 | | Curium * Cm {247} 96 | | Berkelium * Bk {247} 97 | | Californium * Cf {251} 98 | | Einsteinium * Es {252} 99 | | Fermium * Fm {257} 100 | | Mendelevium * Md {258} 101 | | Nobelium * No {259} 102 | | Lawrencium * Lr {262} 103 | | | | | | | |

Ionic Chromatography (IC)



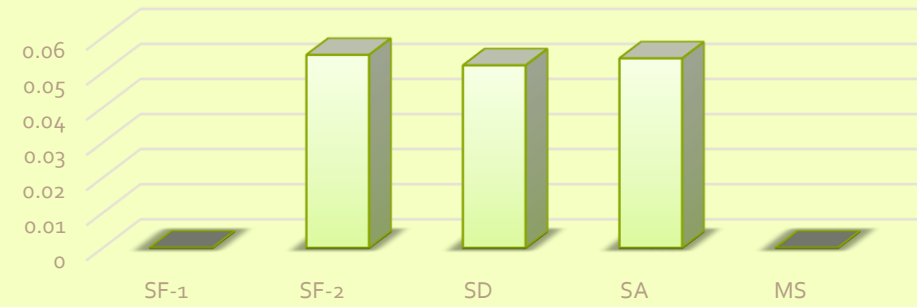
Retention in ionic chromatography is based on attract of solute ions (from the water sample) to charge sites bound for stationary phase.

Dihydrogen Phosphate

Non Detected

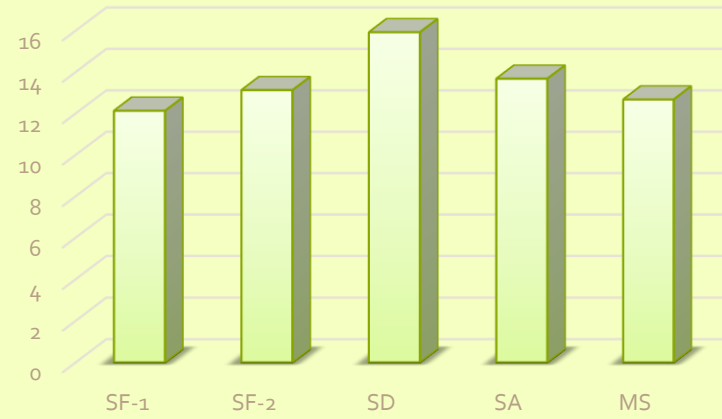
< 0.005mg/L

Br⁻



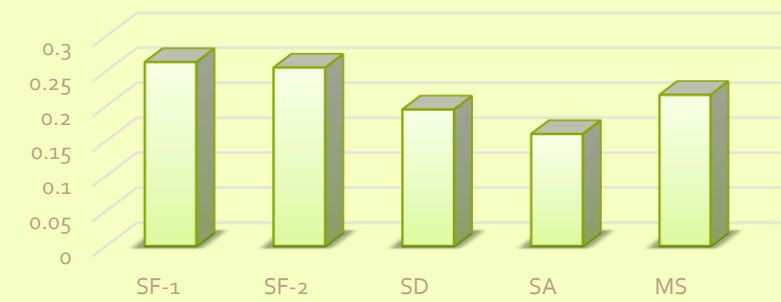
< 0.2mg/L

Cl⁻



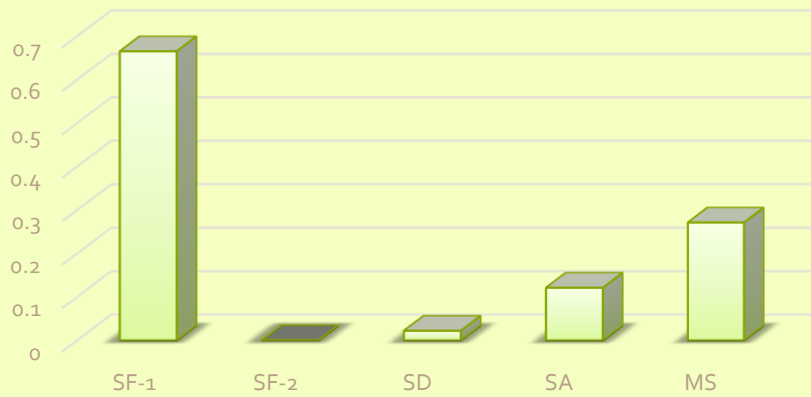
< 200mg/L

F⁻



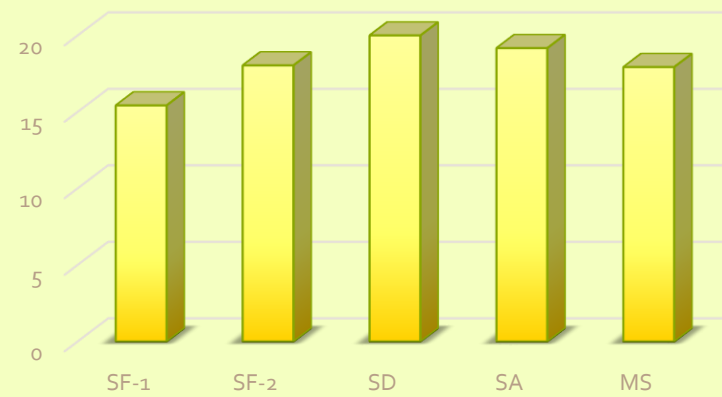
< 1mg/L

NO₂⁻



< 1mg/L

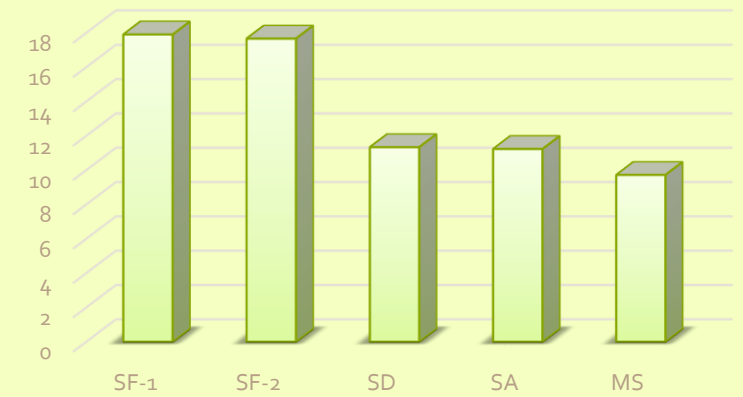
NO₃⁻



< 10mg/L

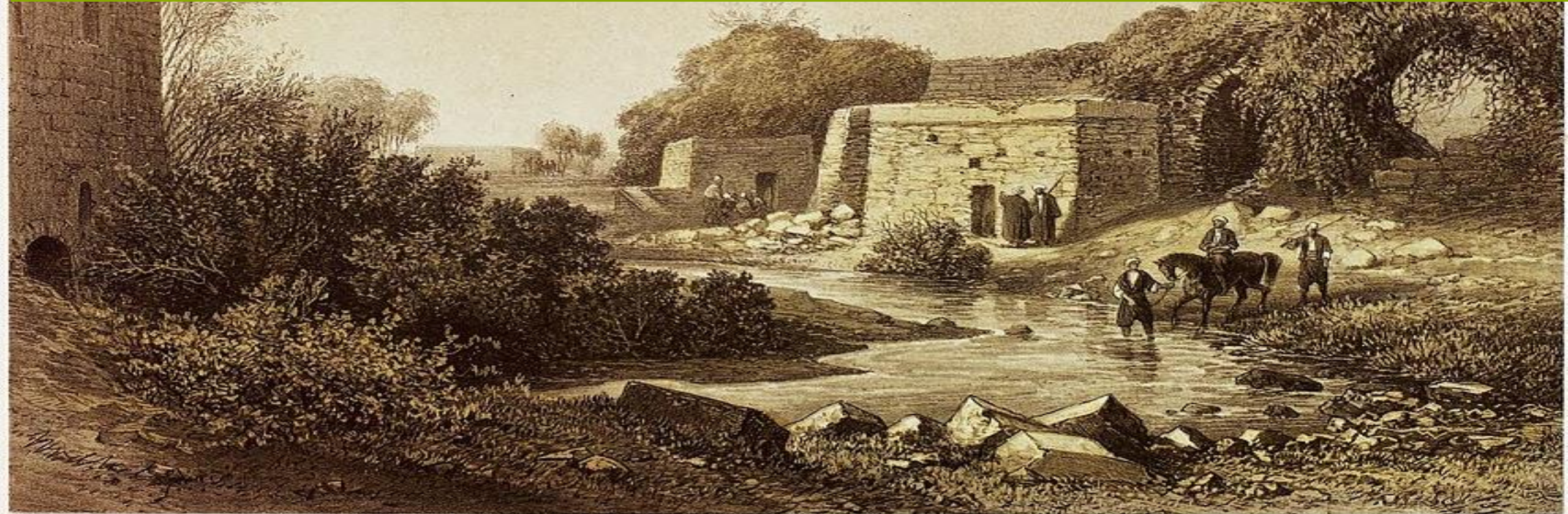
*

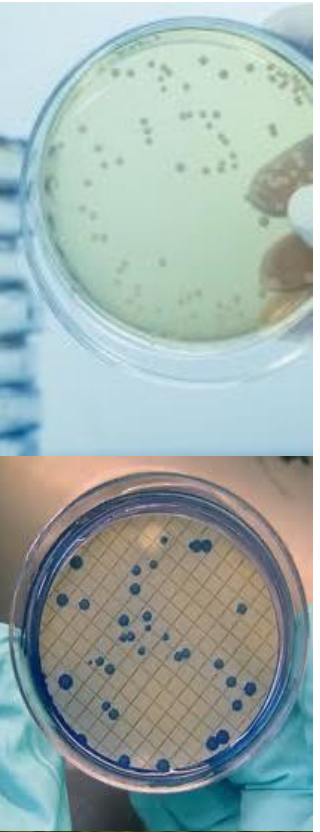
SO₄⁻



< 250mg/L

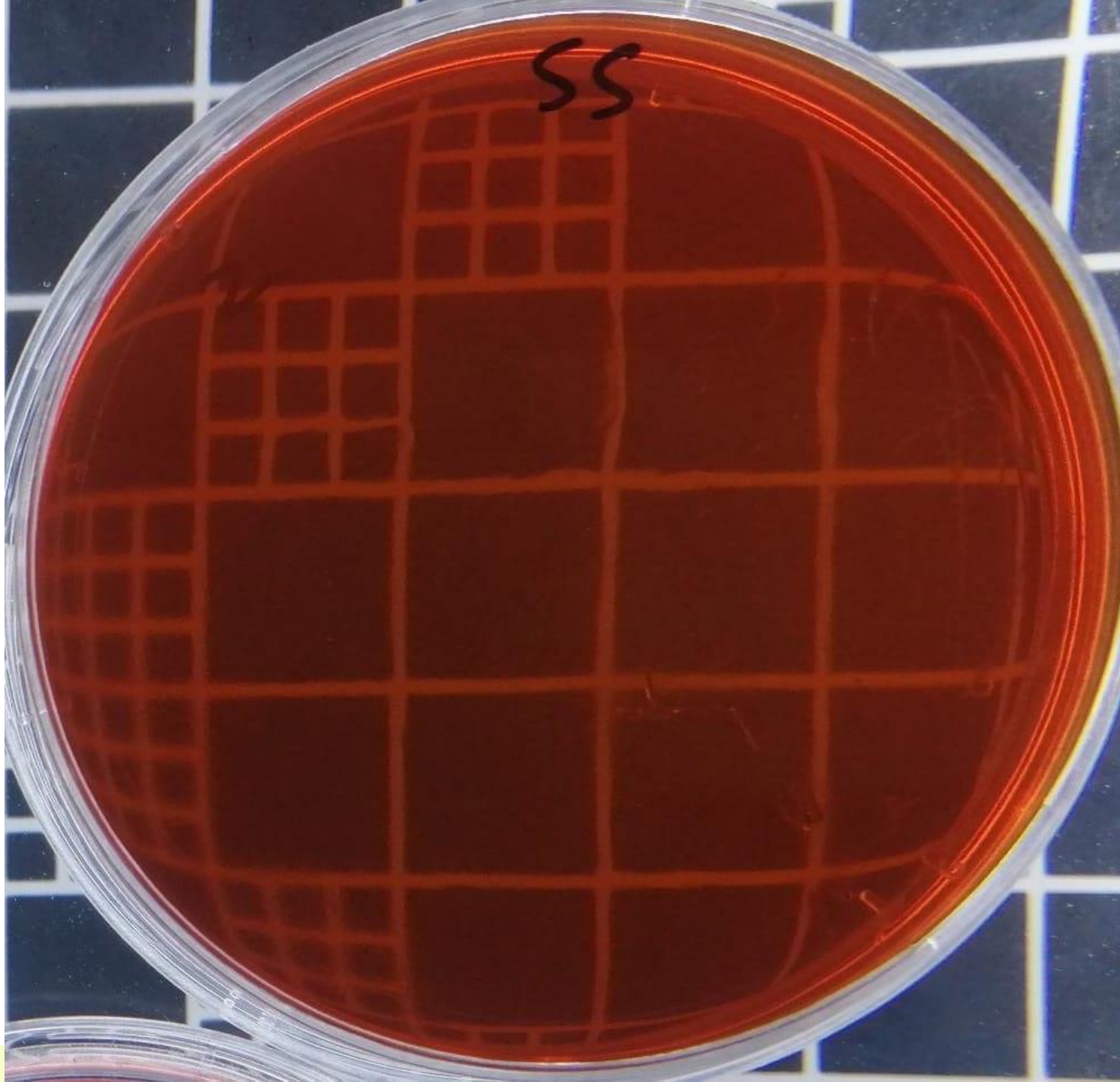
| Designation | Br ⁻ limit 0.2 | Cl ⁻ limit 200 | F ⁻ limit 1 | NO ₂ ⁻ limit 1 | NO ₃ ⁻ limit 10 | H ₂ PO ₄ ⁻ limit 1 | SO ₄ ⁻ limit 250 |
|-------------|------------------------------|------------------------------|---------------------------|---|--|--|---|
| SF-1 | N.D. | 12.124 | 0.263 | 0.665 | 15.42 | N.D. | 17.901 |
| SF-2 | 0.055 | 13.122 | 0.255 | N.D. | 18.039 | N.D. | 17.66 |
| SD | 0.052 | 15.917 | 0.195 | 0.022 | 19.998 | N.D. | 11.334 |
| SA | 0.054 | 13.673 | 0.16 | 0.121 | 19.17 | N.D. | 11.231 |
| MS | N.D. | 12.669 | 0.216 | 0.271 | 17.931 | N.D. | 9.717 |





Microbiological Tests





Salmonella
Shigella agar (SS)
at 37°

Non Detected *

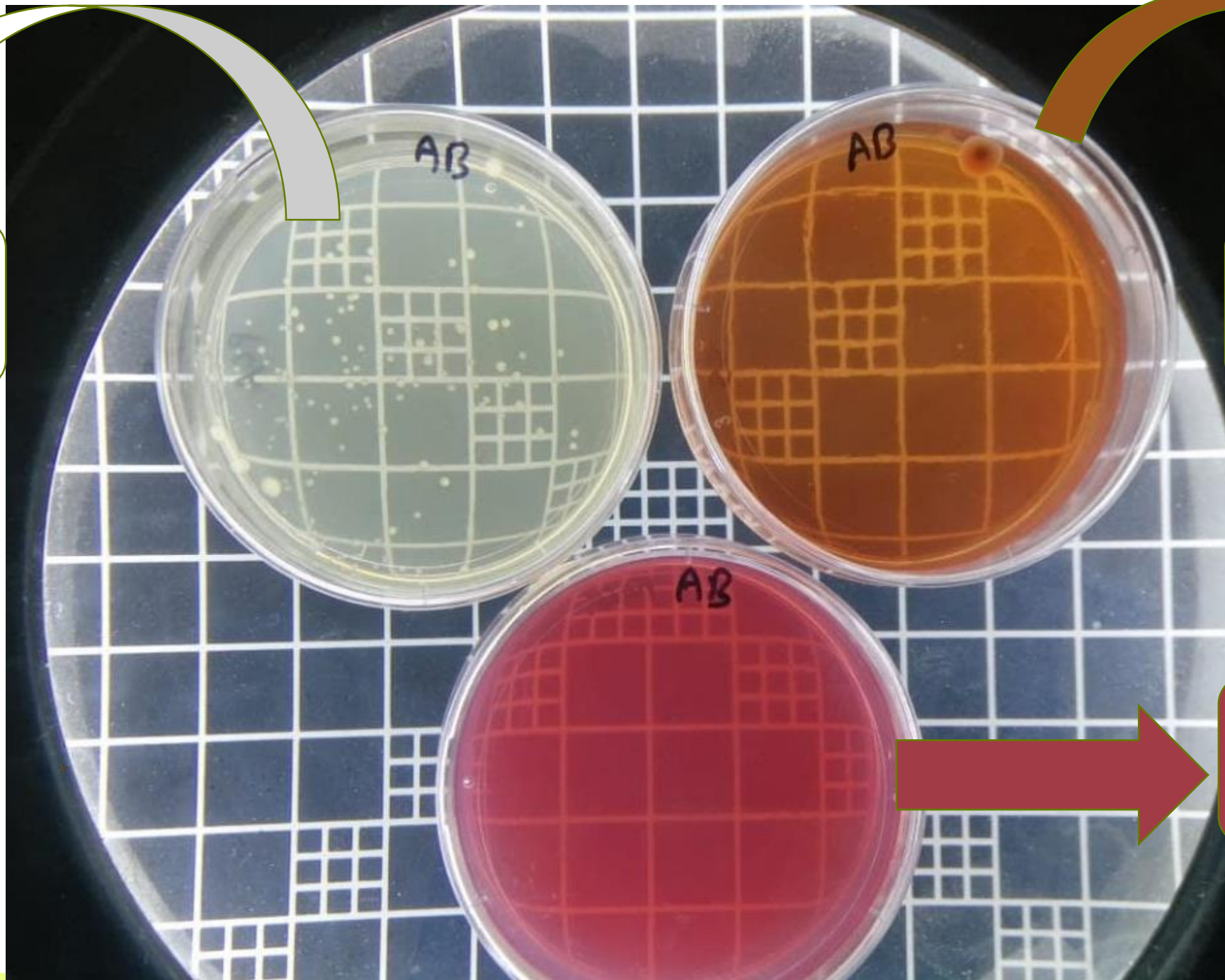
0

Salmonella
Shigella agar (SS)
at 44°

Non Detected

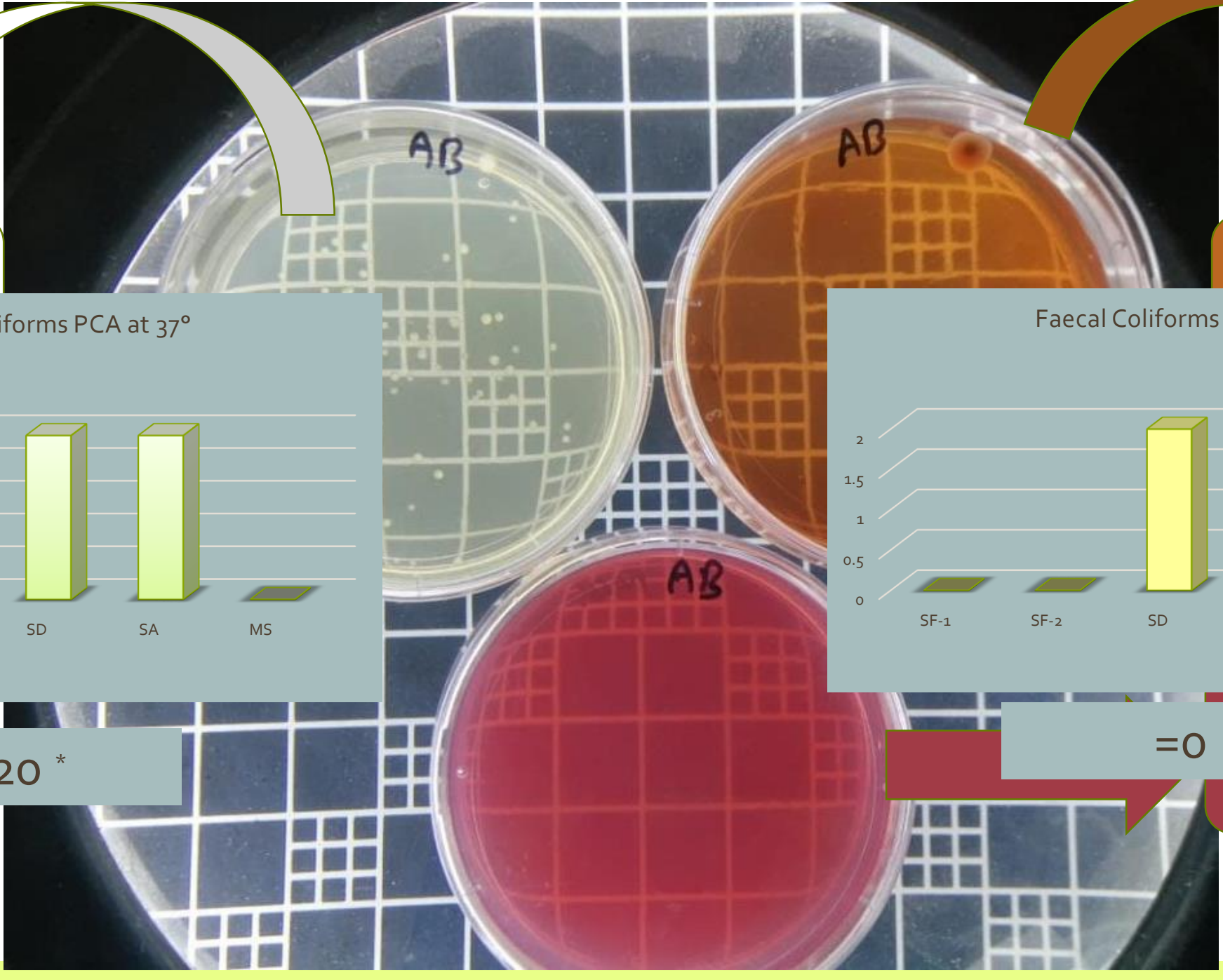
0

Total Coliforms
PCA



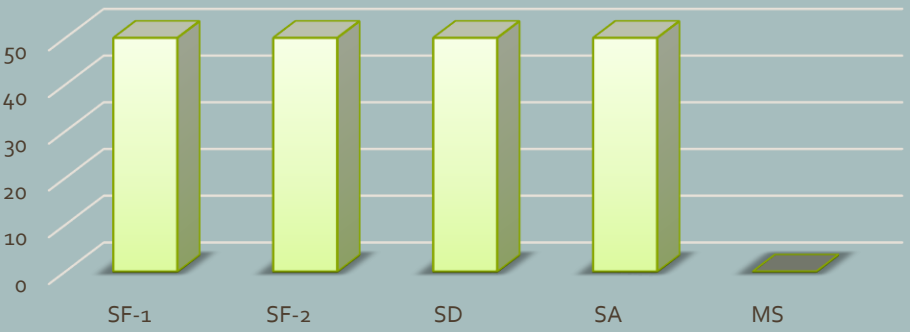
Salmonella
Shigella

Faecal Coliforms



Total Coliforms

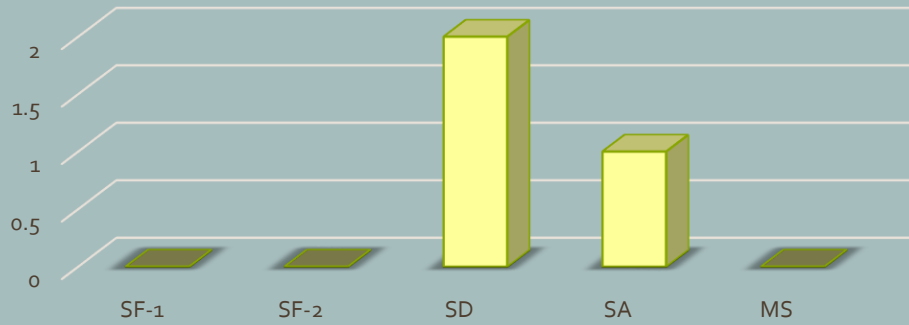
Total Coliforms PCA at 37°



>20 *

Salmonella

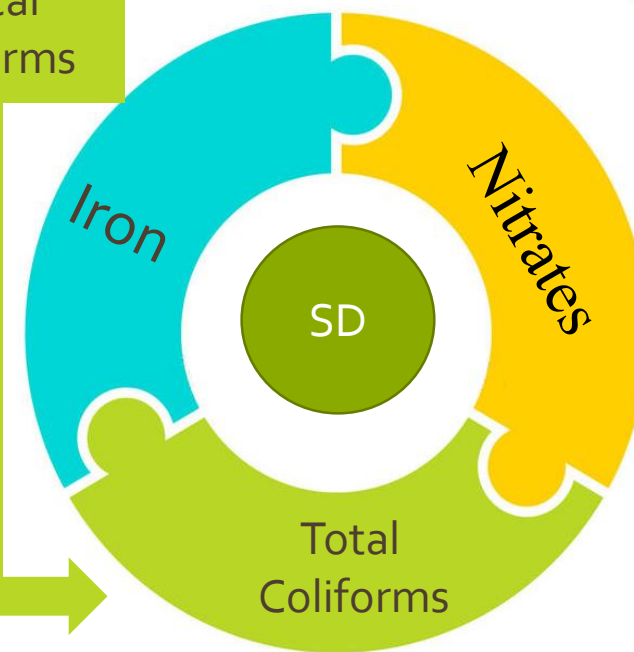
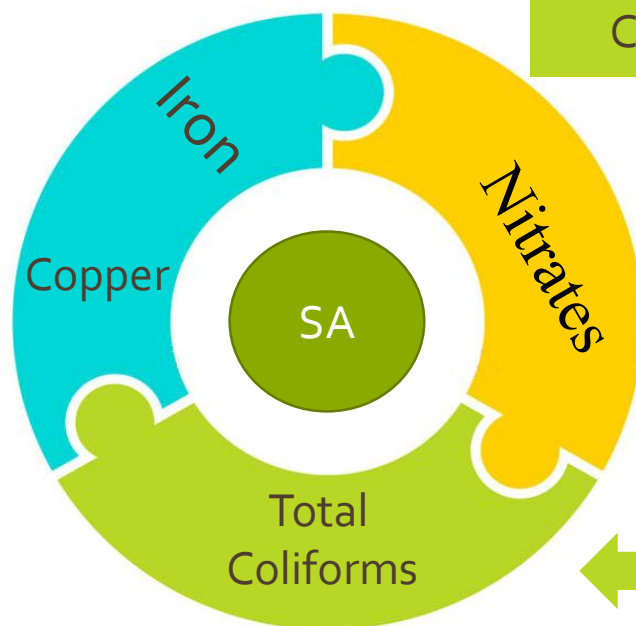
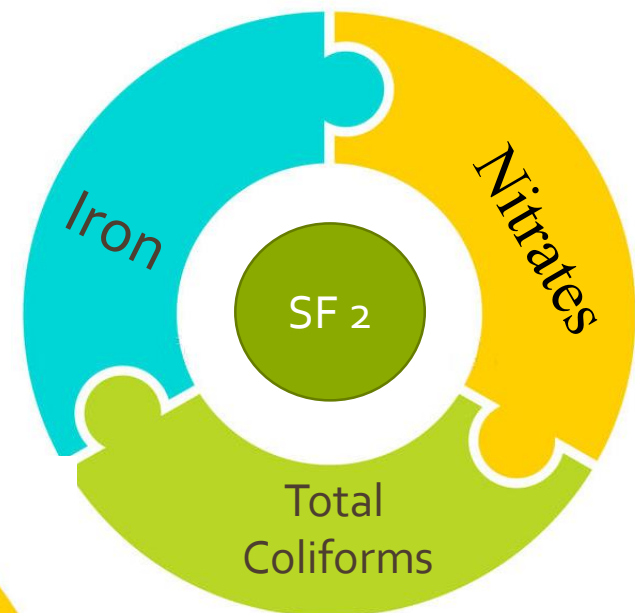
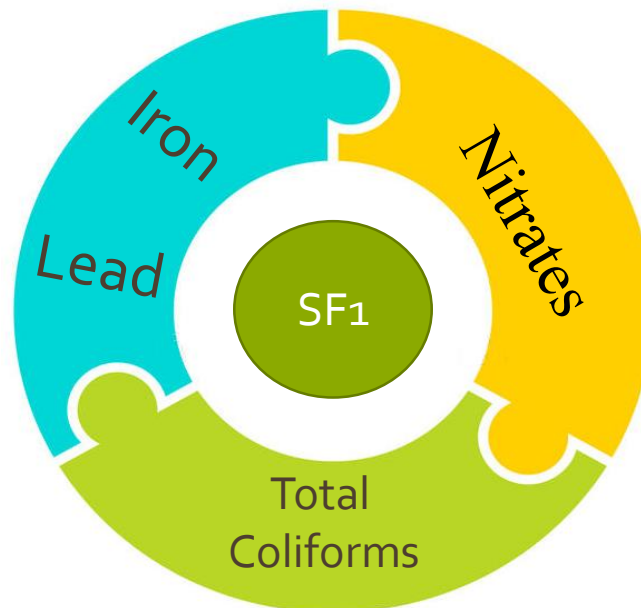
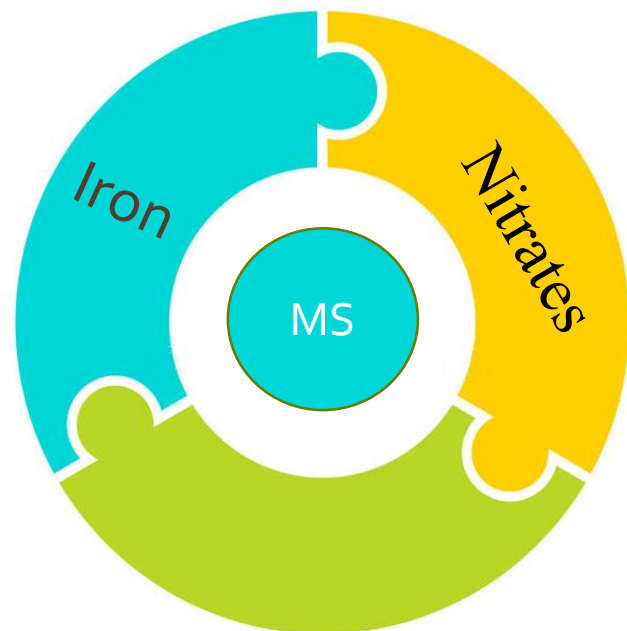
Faecal Coliforms at 44°



=0

Coliforms

Summary *



Faecal Coliforms

Cations

Anions

Microbiological

Discussions

- ❑ The presence of iron in natural water supplies (five sources) is due to rock and mineral decomposition, acidic mine drainage, uncontrolled landfill leaching, sewage effluents, and release from iron processing industrial sectors.
- ❑ The corrosion process in the plumbing systems of old houses or water networks near SF1 increased the dissolution of lead into the water.
- ❑ It was seen that agricultural activities were developed all around the site SA thus hindering the uncontrolled use, and the application of fungicides and algicides leads to the increase in the copper concentrations.

Discussions

- ❑ The high values of nitrates (five sources) are due to the excessive use of domestic waste, and uncontrolled domestic waste spilled near the reservoirs and most importantly the untreated sewage disposed in the area.
- ❑ Due to the existence of Total Coliforms and E. Coli (Faecal Coliforms), the natural water derived from such sources is not suitable for drinking. In addition treatment method should be considered, because they are contaminated and polluted by this bacteria.

Recommendations



Improve the knowledge, and the orientation on the problem of water by integrate the essential aspects of the pollution for water and its sources.

Educate residents about the installation of treatment filters to purify water by suggest materials to dispose of solid, and microbiological pollutants.



Develop monitoring systems to periodically record water quality.

Prevent excessive application of fertilizers to agricultural land.

Dedicate well-defined landfill sites.

Monitor and apply environmental impact studies to preserve the quality of water resources.

Application of the polluter-pays principle to all users.



Legislation and environmental laws should be enforced with a focus on pollution and water consumption.

Government control should be applied over water resource areas, including rivers, springs, and lakes.

Put in place laws regulating the Physiochemical quality of domestic and industrial discharges..

At the End....

- ❑ The discussion of major healthy problems that threaten Lebanon is open....
- ❑ Nowadays, we record the appearance of Cholera.... The Ministry of Public Health announced in a recent published report “220 cases and 6 deaths”.
- ❑ **THANKS' to the organizers of this conference (ISWPT 2022)** that give us the opportunity to participate and highlight on our problem, hope that we can get over this soon.

THANK

YOU



RESERVOIRS OF RÂS EL 'AIN AND PART OF THE ROMAN AQUEDUCT.

Close to this spot stood Palæotyrus, of which no vestige now remains, the materials having been carried away by Alexander (332 B.C.) to construct the mole or causeway which unites insular Tyre to the mainland.