Water Quality Assessment of Abu Ali's Watershed for Domestic and Agriculture Use

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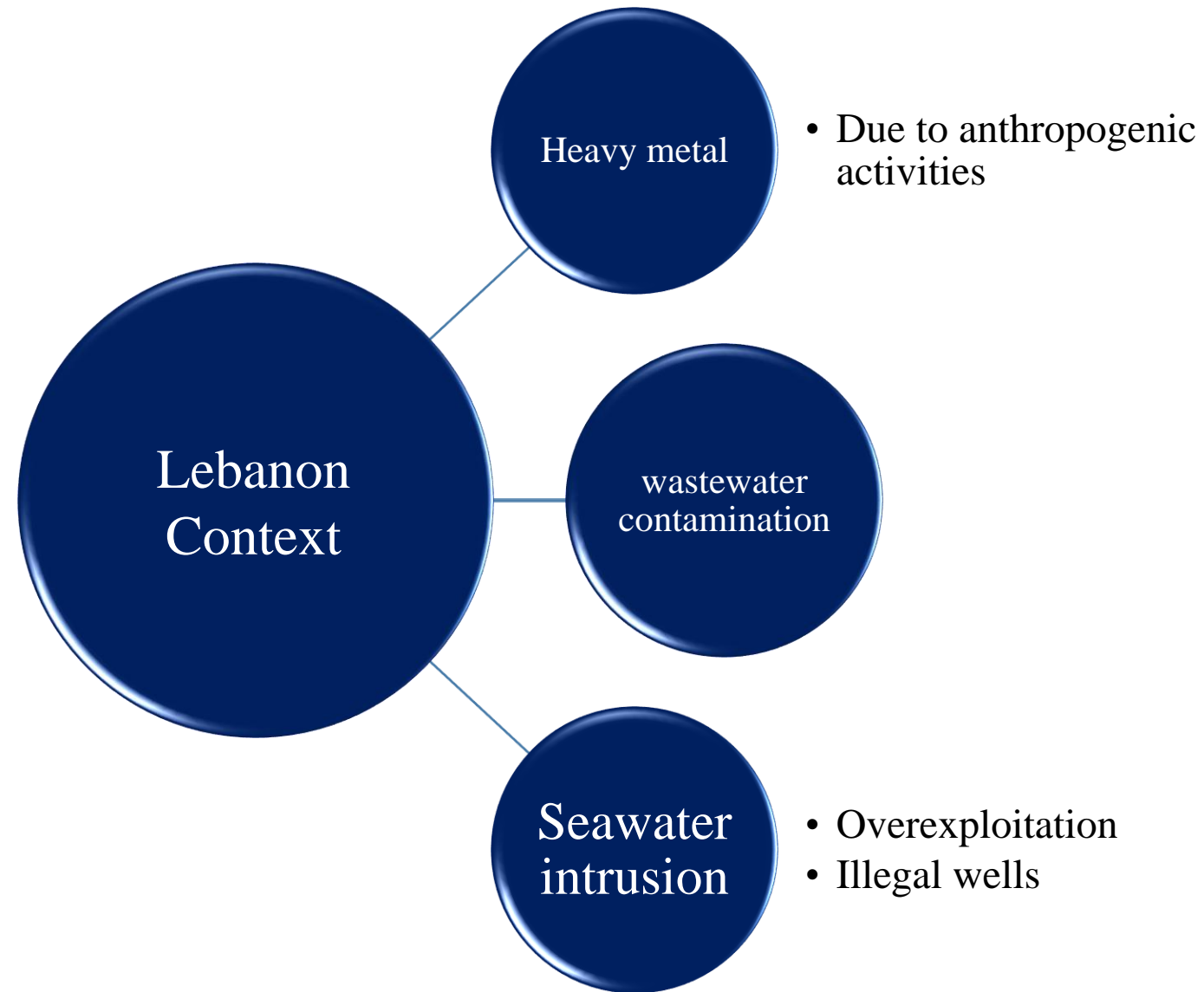
Outline

1. General Introduction

2. General Objectives

3. Study Area Description

4. Materials and Methods

    4.1 Sampling and Laboratory work

    4.2 Data Analysis

5. Results and Discussion

    5.1 Domestic Use

    5.2 Irrigation Water Quality

    5.3 Lebanese Comparison

6. General Conclusion

Outline

- **Water is a pivotal natural resource.**

- **Despite that, its quality and quantity could be jeopardized by several anthropogenic factors.**

- **And Lebanon is no exception**

Lebanon Context

Heavy metal
- Due to anthropogenic activities

wastewater contamination

Seawater intrusion
- Overexploitation
- Illegal wells

Furthermore, 3 studies conducted on Abu Ali river located north of Lebanon.

1. The first study proved that 21 pesticides contaminate Abu Ali river.

2. Meanwhile, the other 2 studies proved that Abu Ali river is polluted with several PAHs.

3. However, the contamination level in the groundwater samples were minimal.

The aim of this study is to assess the water quality of Abu Ali's watershed for domestic use and agriculture activities.
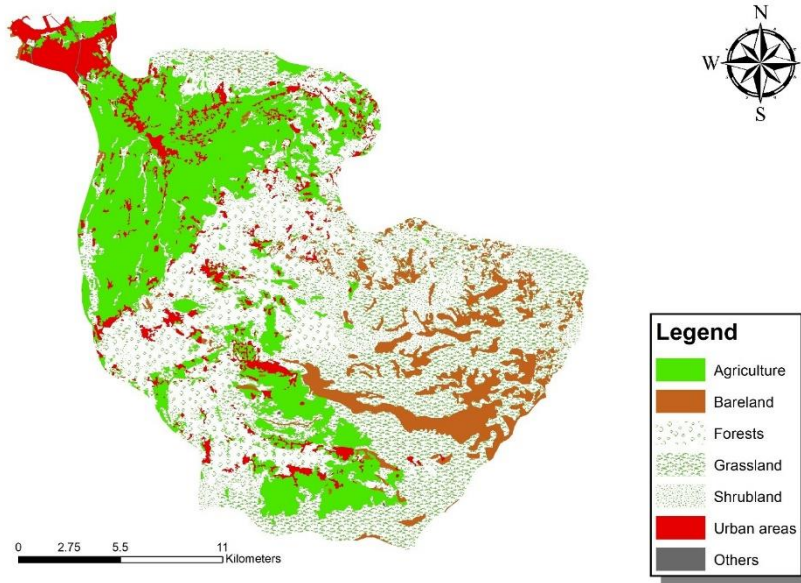
Outline

3. Abu Ali basin

Total area = 489 Km^2

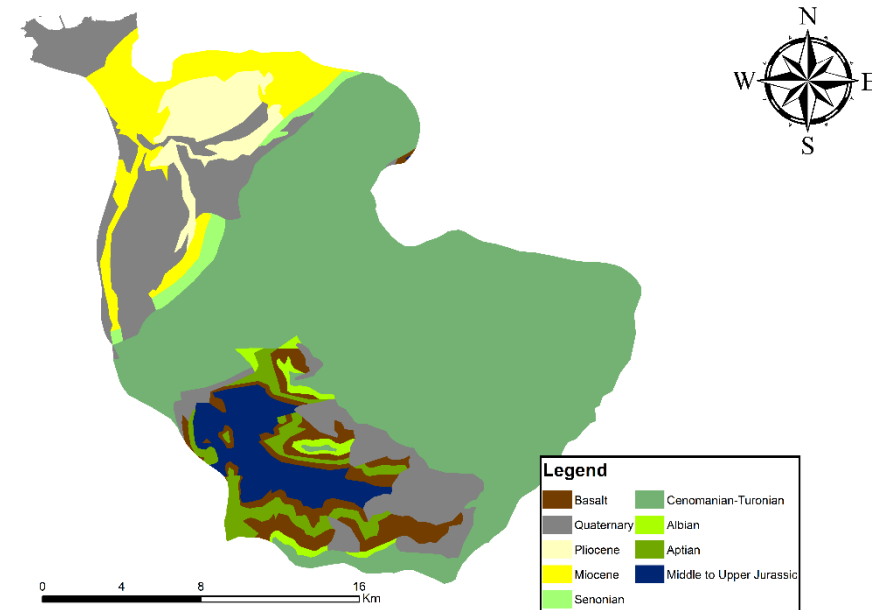600,000 residents

Elevation reach 3083 m

Mediterranean climate

Mean discharge rate = 262 million m^3
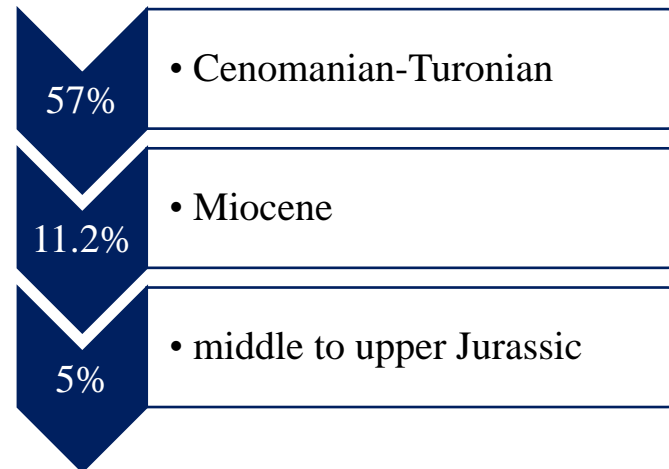
3.2 Abu Ali basin

Land cover use map.
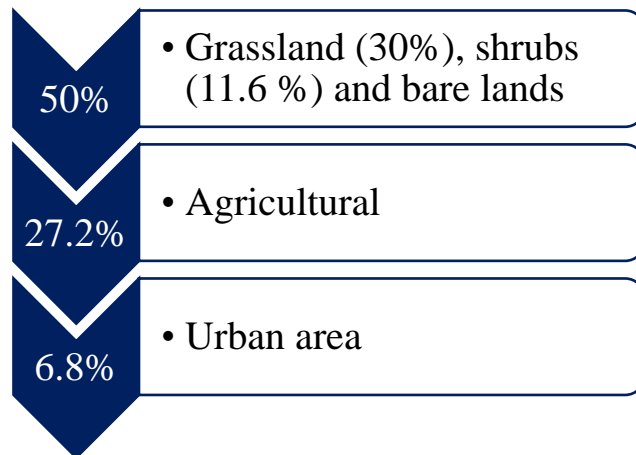
Geology map

50% • Grassland (30%), shrubs (11.6 %) and bare lands

27.2% • Agricultural

6.8% • Urban area

57% • Cenomanian-Turonian

11.2% • Miocene

5% • middle to upper Jurassic

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Outline

4.1 Sampling and Laboratory work

Parameters measurements

1. 50 samples were collected during 5 campaigns, where the same 10 samples were collected during December 2022, January 2023, April 2023, May 2023 and June 2023.

2. On the **field** → Temperature **(TᵒC), Turbidity, pH**, Electrical Conductivity **(EC)** and Total Dissolved Solid **(TDS)**

5 - Rachiine
8 - Daraya
7 - Feskin
10 - Ras Kifa
6 - Ziret Tineh   4 - Ghabash
9 - Mazraet Nahr
3 - Mar Sarkis
2 - Mar Semaan
1 - Quadisha

Legend
- River
- Spring
- Well
- River
- Basalt
- Quaternary
- Pliocene
- Miocene
- Senonian
- Cenomanian-Turonian
- Albian
- Aptian
- Middle to Upper Jurassic

Elevation
High: 3082m
Low: 0m

0 4 8 16 Km
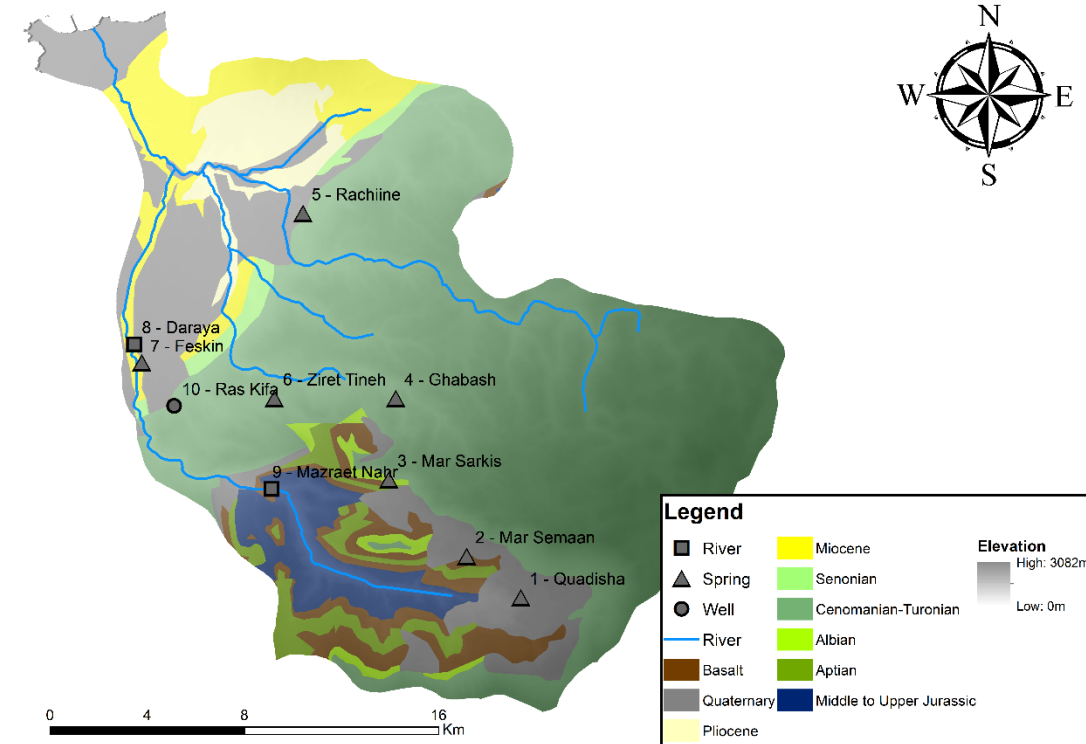
4.1 Sampling and Laboratory work

Parameters measurements

3.   While in **laboratory** Via

    a)   **Portable Laboratory "ODEON SN-ODEOA-4546"** ➔ **calcium, magnesium, bicarbonate, chloride, nitrate, sulfate and phosphate.**

    b)   **Flame atomic absorption spectroscopy (FAAS) and ion chromatography** ➔ **sodium and potassium.**

    c)   **Membrane filtration** ➔ *E. Coli.*

4.2 Data Analysis

Parameters measurements

In order to assess the quality of Abu Ali's water several plots and indexes were analyzed:

1. For **domestic** use ➔ the concentrations were compared to the thresholds put by **WHO and EPA**.

2. For the **irrigation** quality:

   a) The **7 indices**: Residual Sodium Carbonate **(RSC)**, Sodium percentages **(%Na)**, Sodium Absorption Rate **(SAR)**, Permeability Index **(PI)**, Kelly's ratio **(KR)**, Magnesium ratio **(MR)** and Total concentration **(T.conc.)** were computed.

   b) The samples were plotted into **Wilcox diagram, USSL plot and Doneen plot**.

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5.1 Domestic Use

	Min	Mean	Max	Thresholds	Samples exceeding Threshold	References
T (°C)	-2	9.86	20	N.A.	N.A.	N.A.
pH	7.27	7.78	8.63	6.5–8.5	5	WHO 2017
EC (µS/cm)	164.5	366.49	712	N.A.	N.A.	N.A.
TDS (mg/L)	48	180.31	456	600 mg/L	0	WHO 2017
Turbidity (NTU)	0.12	2.74	28.86	5	5	WHO 2017
E. Coli (CFU/100mL)	N.D.	N.D.	N.D.	0 CFU/100mL	32	WHO 2017
Ca^{2+} (mg/L)	22.3	48.02	80.2	N.A.	N.A.	N.A.
Mg^{2+} (mg/L)	2.1	5.59	10.1	N.A.	N.A.	N.A.
Na^+ (mg/L)	0.19	12.58	62.4	200 mg/L	0	EPA 2018
K^+ (mg/L)	0	0.61	1.6	N.A.	N.A.	N.A.
HCO_3^- (mg/L)	53.7	128.55	225.7	N.A.	N.A.	N.A.
Cl^- (mg/L)	3.4	34.92	91.9	250 mg/L	0	WHO 2017
NO_3^- (mg/L)	1.3	9.4	30.8	50 mg/L	0	WHO 2017
SO_4^{2-} (mg/L)	0.3	2.46	6.9	250 mg/L	0	EPA 2018
PO_4^{3-} (mg/L)	0.3	0.62	1.3	N.A.	N.A.	N.A.

5.1 Domestic Use

- TDS and major ions thresholds, except for nitrate, are taste thresholds, as result the samples trespassing these limits does not impose serious health problems on consumers.

- All nitrate concentrations falls below the threshold. As a result, none of the samples presents a serious health risk ➜ methemoglobinemia (newborn and infants).

- 32 samples were contaminated by *E.Coli* ➜ The water is considered unsuitable for drinking.

Outline

5.2 Irrigation Water Quality

5.2.1 Residual sodium carbonate (RSC) and Sodium percentage (%Na)

RSC	Quality	number of samples
<1.25	Safe	50
1.25-2.5	Marginally Suitable	0
>2.5	Unsuitable	0

%Na	Quality	No. of samples
<20	Excellent	38
20-40	Good	12
40-60	Permissible	0
60-80	Doubtful	0
>80	Unsuitable	0
Total		50

5.2 Irrigation Water Quality

5.2.2 Gibbs plots
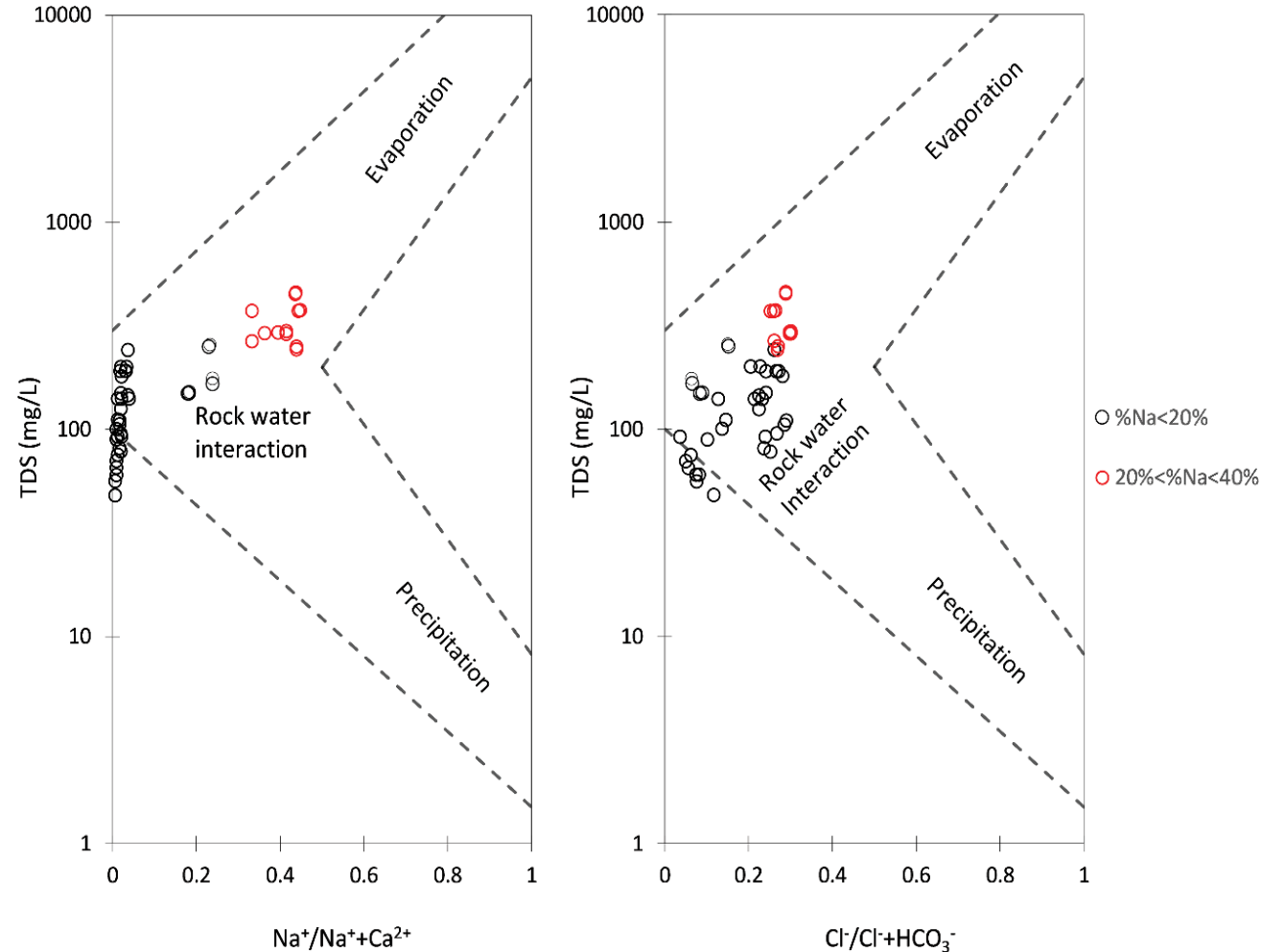
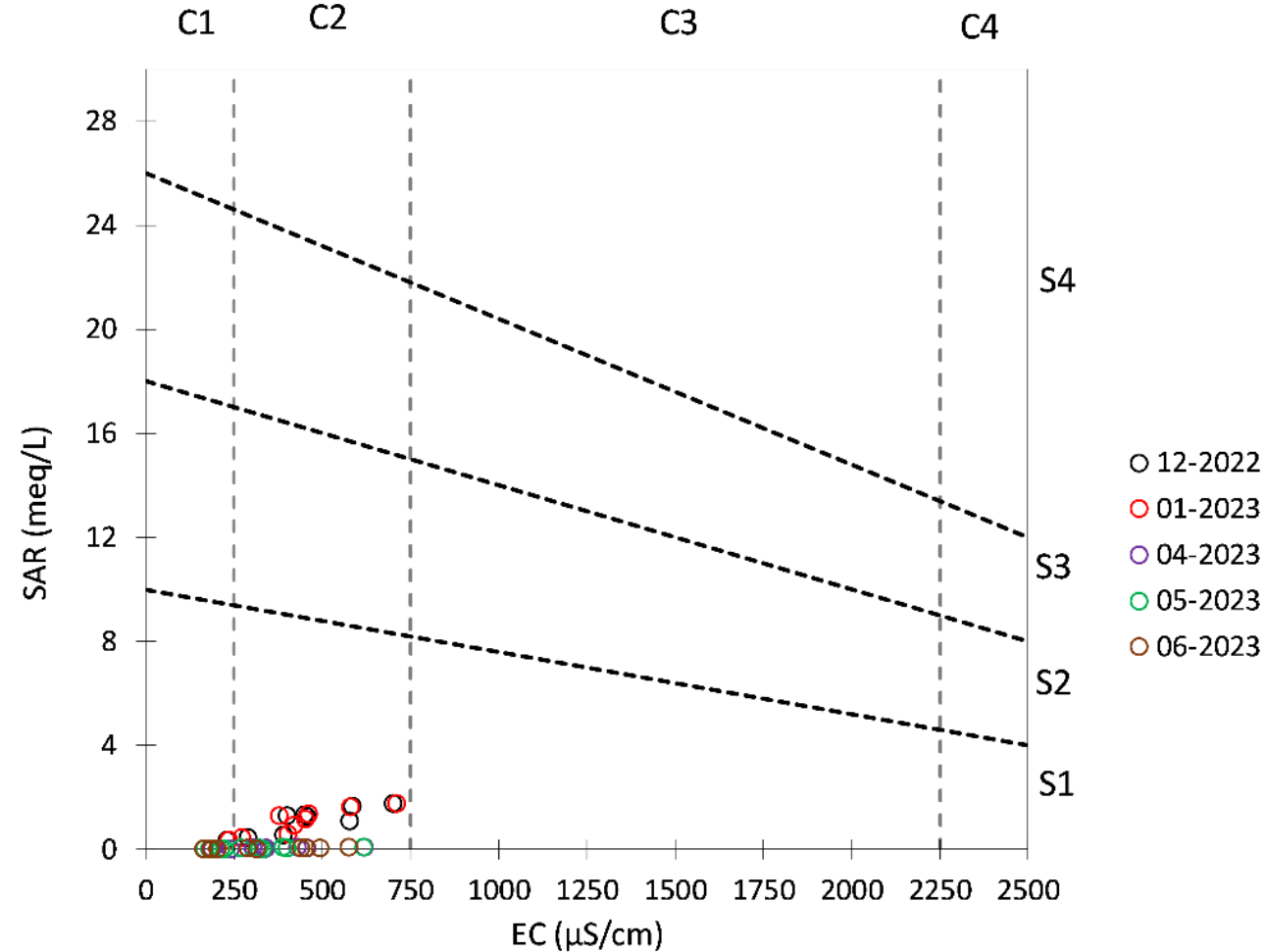| %Na	Quality	No. of samples
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60-80	Doubtful	0
>80	Unsuitable	0
Total		50

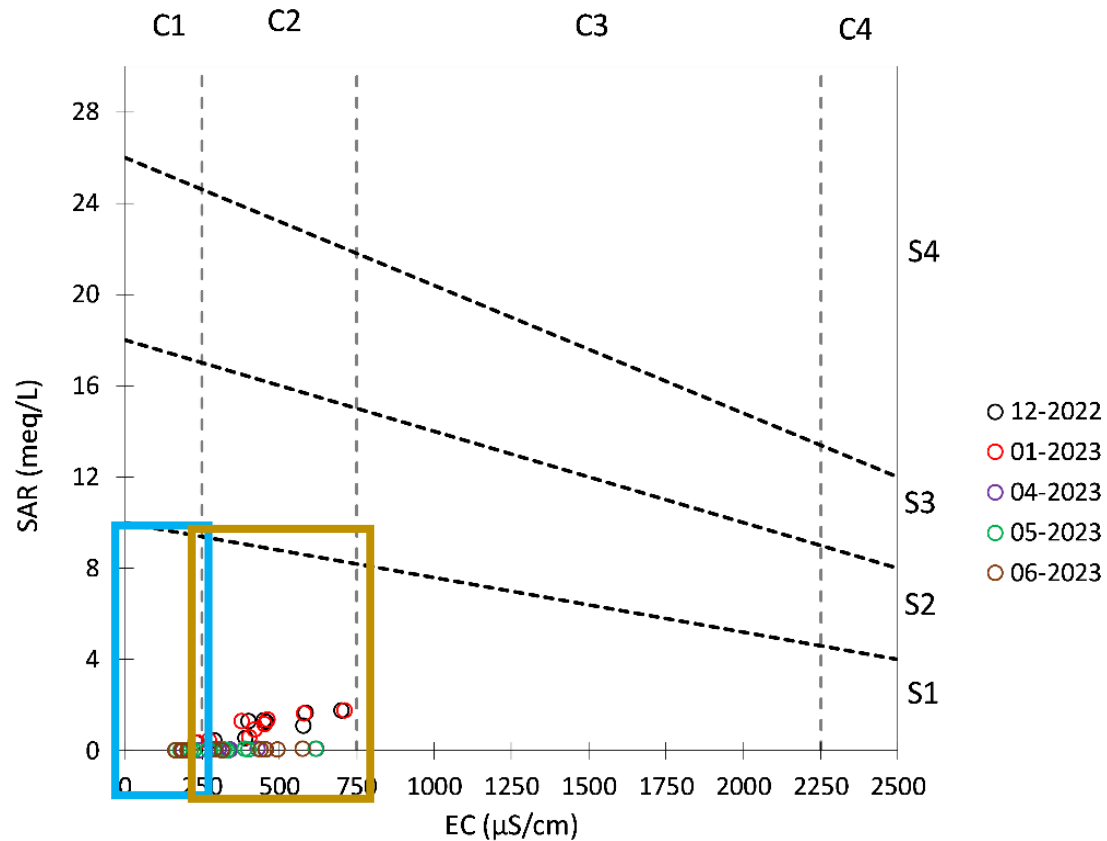# 5.2 Irrigation Water Quality

5.2.3 Wilcox diagram
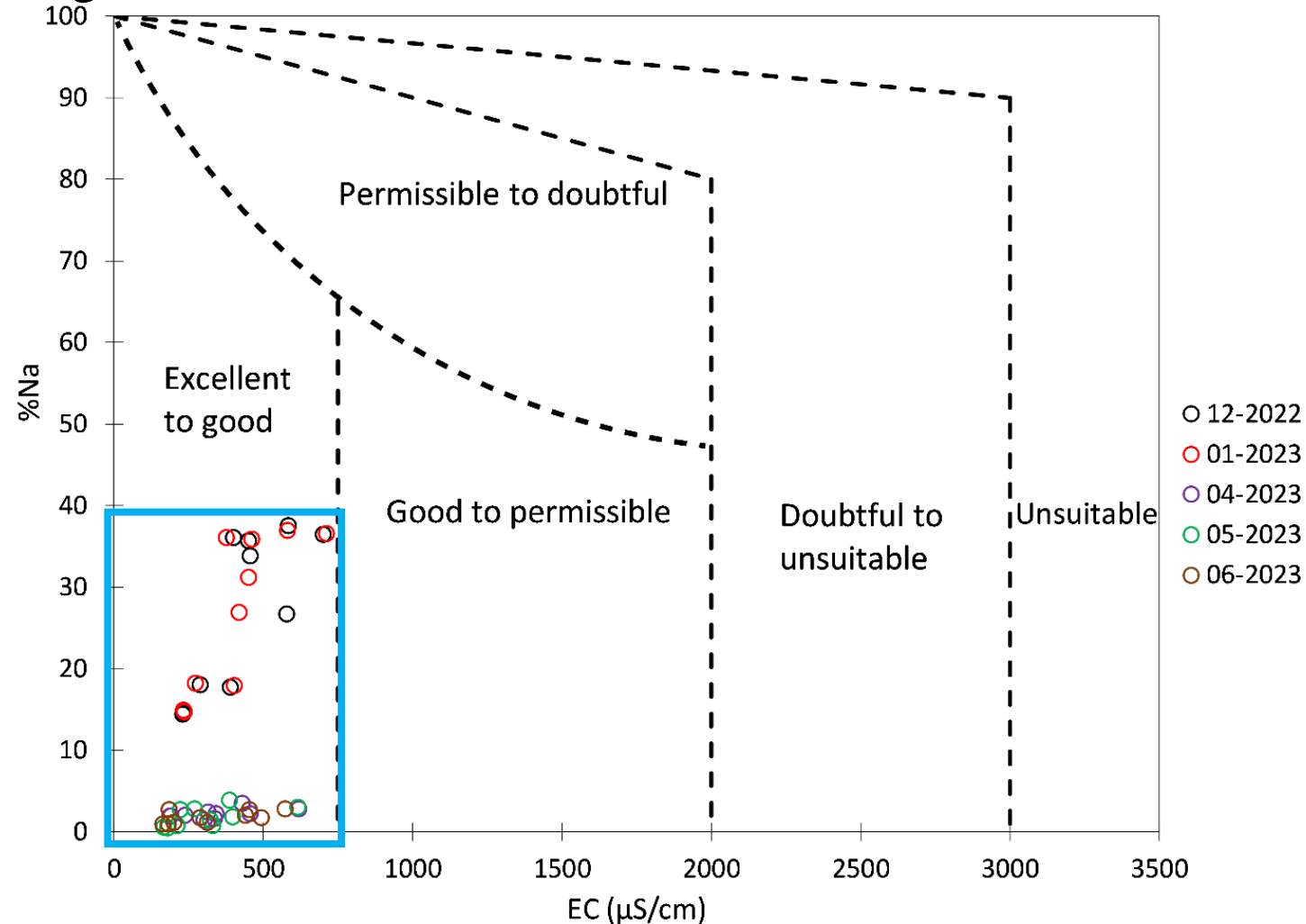
5.2 Irrigation Water Quality

5.2.4 USSL diagram and Sodium absorption ratio (SAR)
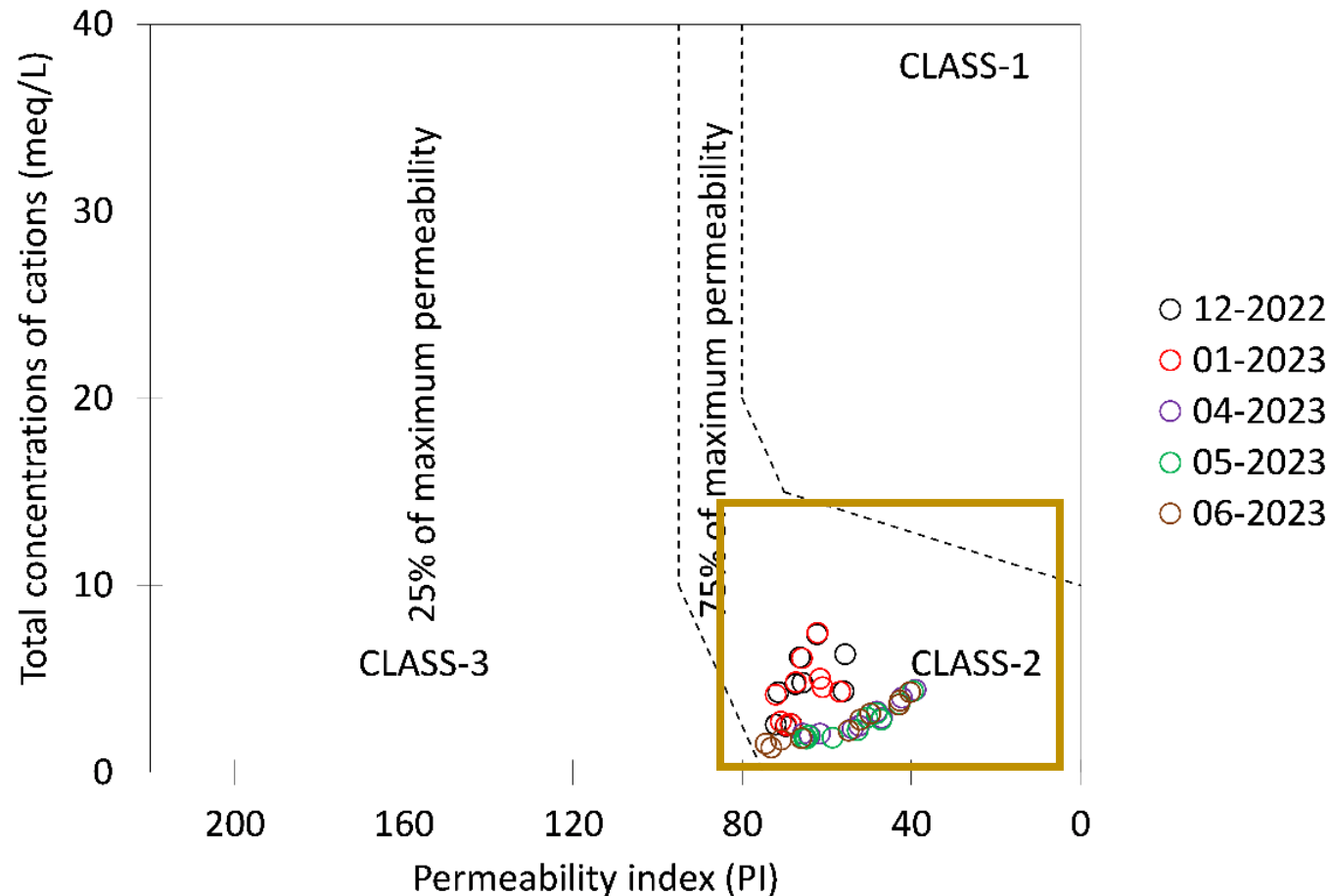
5.2 Irrigation Water Quality

5.2.4 USSL diagram and Sodium absorption ratio (SAR)

Salinity Hazard (Conductivity)	Quality	number of samples	Salinity Hazard samples
<250	Low	15	Mar Sarkis, Mar Semaan
250-750	Medium	35	The Rest
750-2250	High	0	-----------------------------------
>2250	Very High	0	-----------------------------------

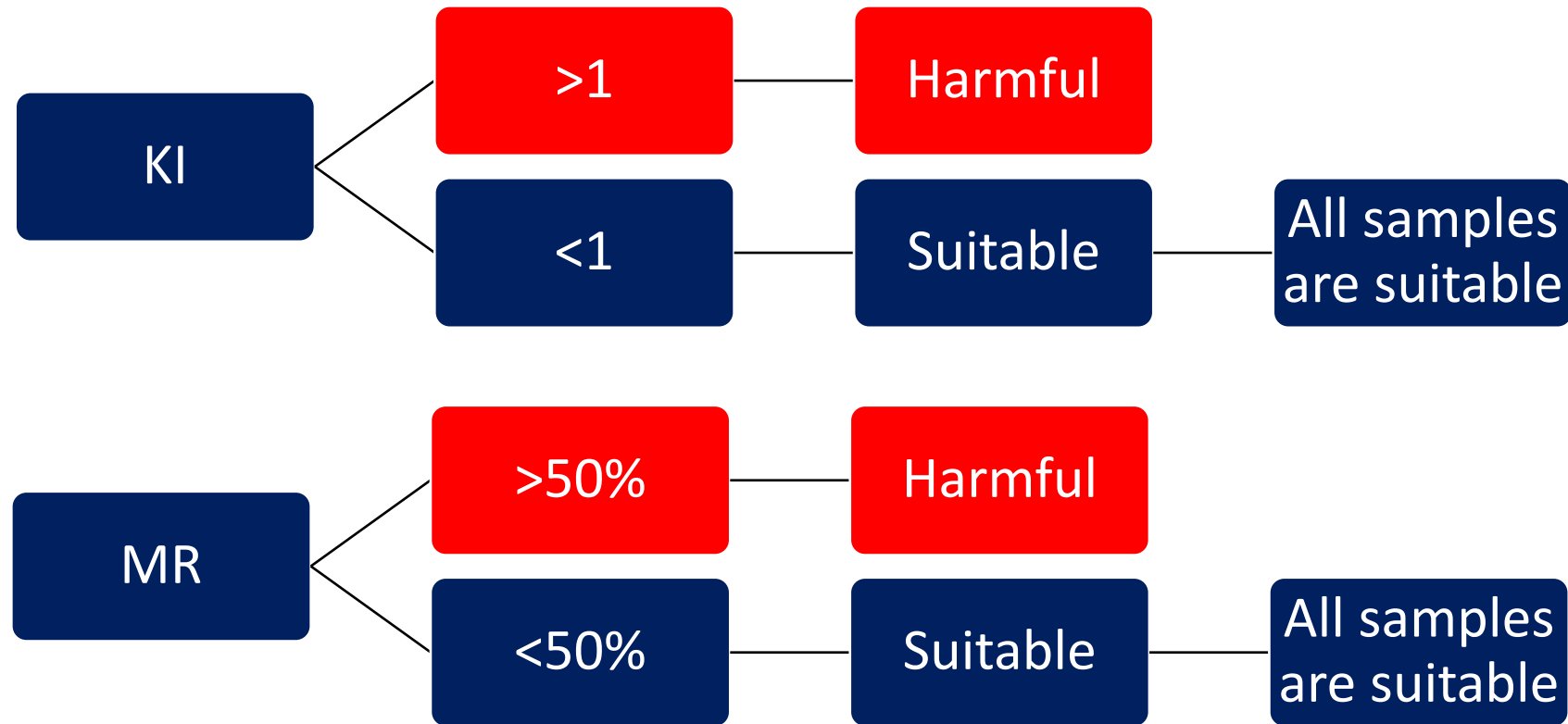# 5.2 Irrigation Water Quality

5.2.5 Doneen plot

5.2 Irrigation Water Quality

5.2.6 Kelly's index (KI) and Magnesium ratio (MR)

KI
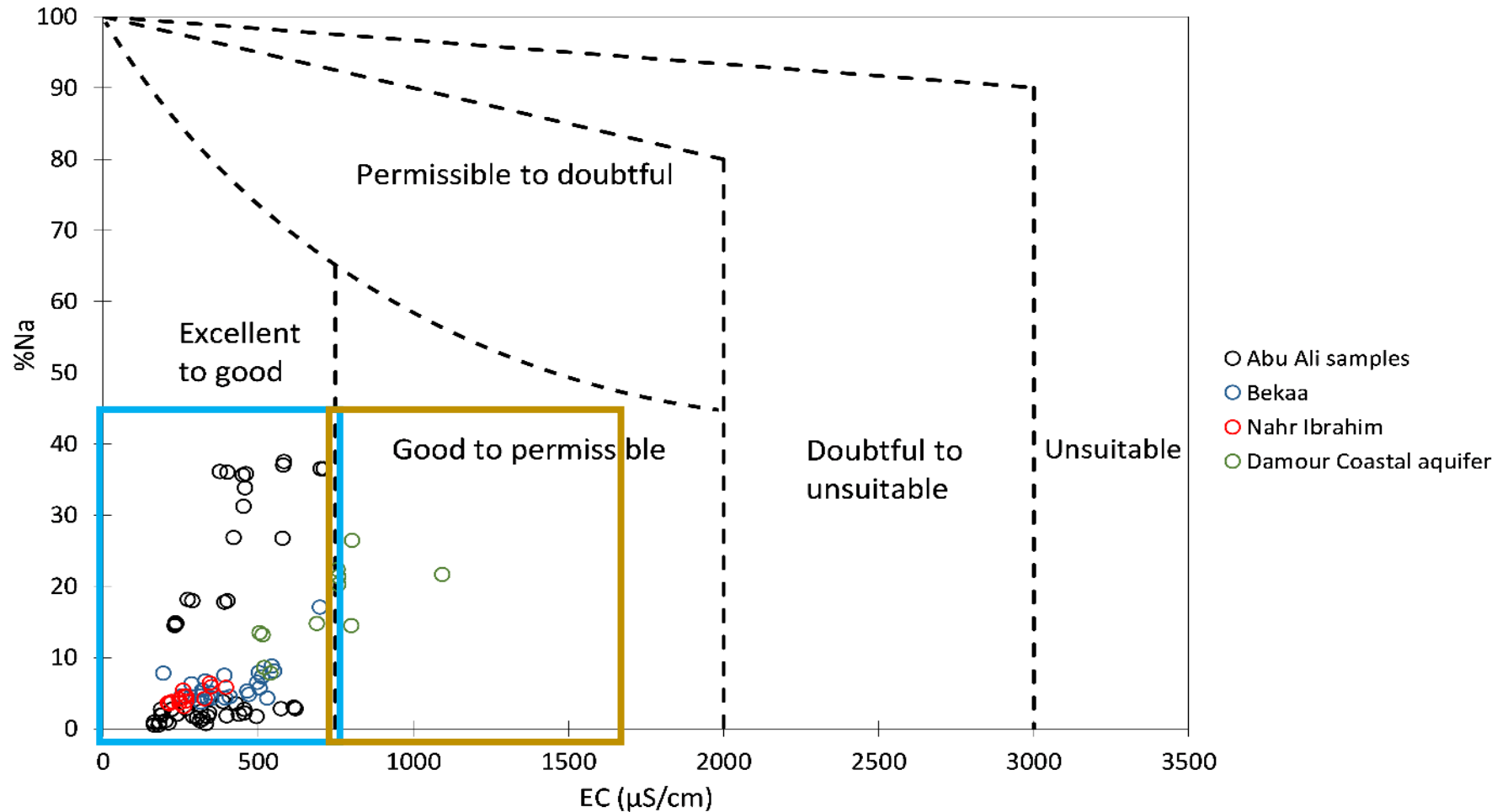- >1 — Harmful
- <1 — Suitable — All samples are suitable

MR
- >50% — Harmful
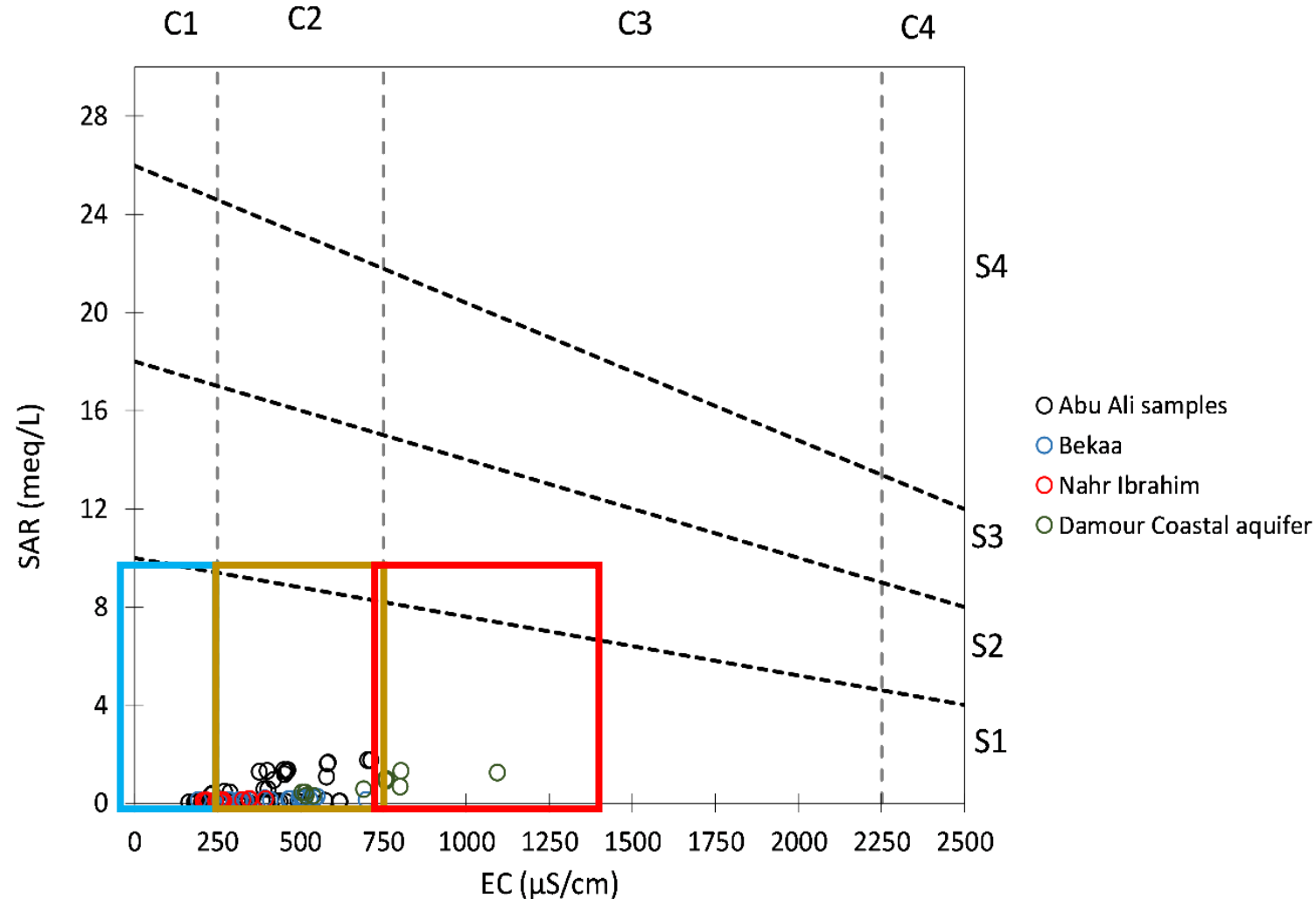- <50% — Suitable — All samples are suitable

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Outline

5.3 Lebanese Comparison

5.3.1 Wilcox diagram

5.3 Lebanese Comparison

5.3.2 USSL diagram

5.3 Lebanese Comparison

5.3.3 Doneen plot
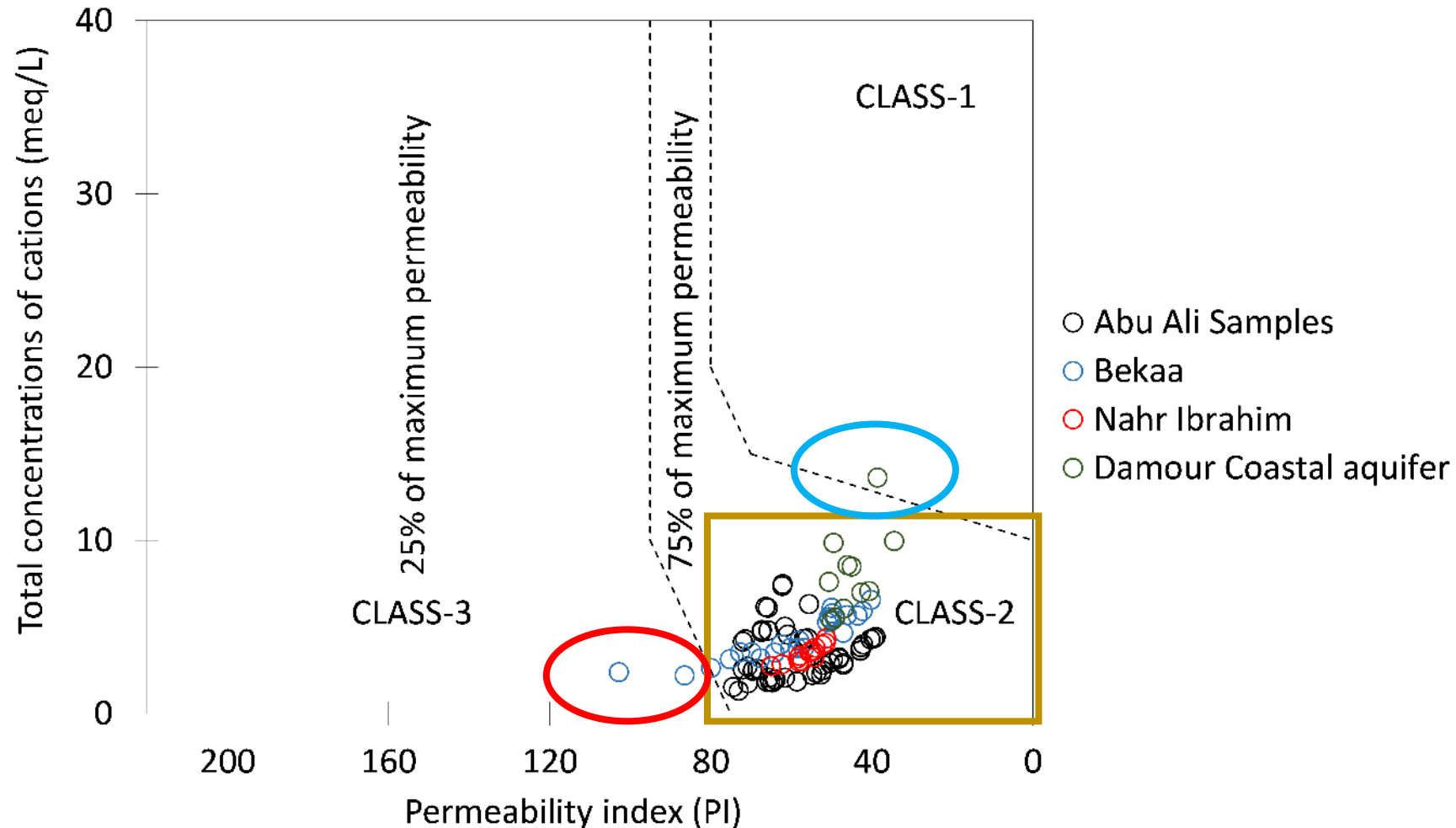
Outline

6. General Conclusion

- Water is a pivotal natural resource that could be jeopardized by several anthropogenic factors worldwide and in Lebanon.

- The aim of this study is to assess the water quality of Abu Ali's watershed for domestic use and agriculture activities.

6. General Conclusion

- 50 samples were collected during 5 months

- Temperature, turbidity, pH, electrical conductivity (EC), total dissolved solids (TDS), calcium, magnesium, sodium, potassium bicarbonate, chloride, nitrate, sulfate and phosphate were measured.

- 7 indexes were computed: %Na, SAR, PI, RSC, KI, MR and T.conc.

- Several diagrams were plotted: Wilcox diagram, USSL diagram and Doneen plot.

6. General Conclusion

- For domestic use, the major ions concentrations of Abu Ali's samples were below the thresholds. However, Abu Ali's water is deemed unsuitable for drinking due to _E. Coli_ contamination.

- For irrigation use, the RSC, Kelly's index and magnesium ratio values were low and indicate that the samples are safe for agriculture practices.

- Meanwhile, the sodium percentages were high in 12 samples, which are considered less suitable for irrigation. → Gibbs plots prove that evaporation play an active role in increasing these percentages.

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6. General Conclusion

- Wilcox diagram → all Abu Ali's samples are considered excellent to good.

- USSL diagram → All samples are distributed between 2 levels of salinity hazardous: low and medium → 35 samples are less suitable.

- Doneen plot → all samples fall into the class-2 zone → diminish the soil permeability by 25%.

6. General Conclusion

- Comparison between Lebanese studies: Abu Ali, Bekaa, Nahr Ibrahim and Damour coastal aquifer

- Similar pattern was observed between these 4 studies in Wilcox diagram, USSL diagram and Doneen plot.

- Which indicate that the state and quality of Abu Ali's watershed is comparable to other water sources in Lebanon.

Thanks for your attention !