Assessment of groundwater suitability for drinking and irrigation purposes using physicochemical parameters at Al-Jouf Area, Saudi Arabia

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Overview

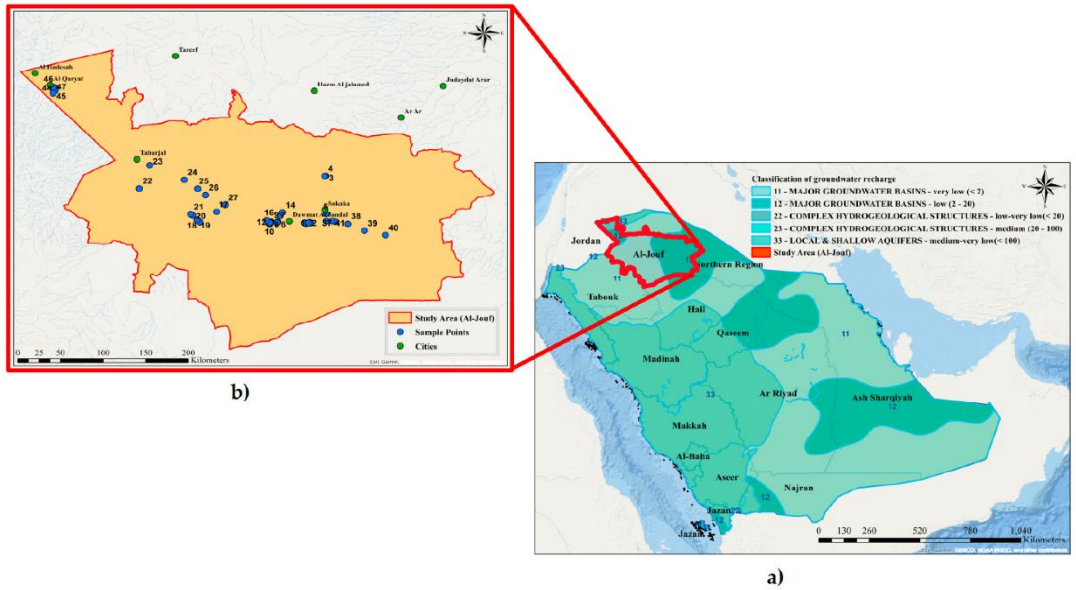
- Introduction
- Objectives
- Methodology
- Results
- Conclusion

Introduction

- Rising water demand in Saudi Arabia due to population growth and agriculture.
- Desalination and groundwater extraction are relied upon but degrade groundwater quality with contaminants like sulfate, magnesium, CO2, sodium, and chlorine.
- Adherence to water quality standards from organizations like SASO, BIS, and WHO is critical.
- Water Quality Index (WQI) and indicators like EC, Na+ %, MH, PS, SAR, and KR assess groundwater quality for irrigation.
- Studies across Saudi Arabia reveal varying groundwater quality impacts on suitability for drinking and irrigation.

Objectives

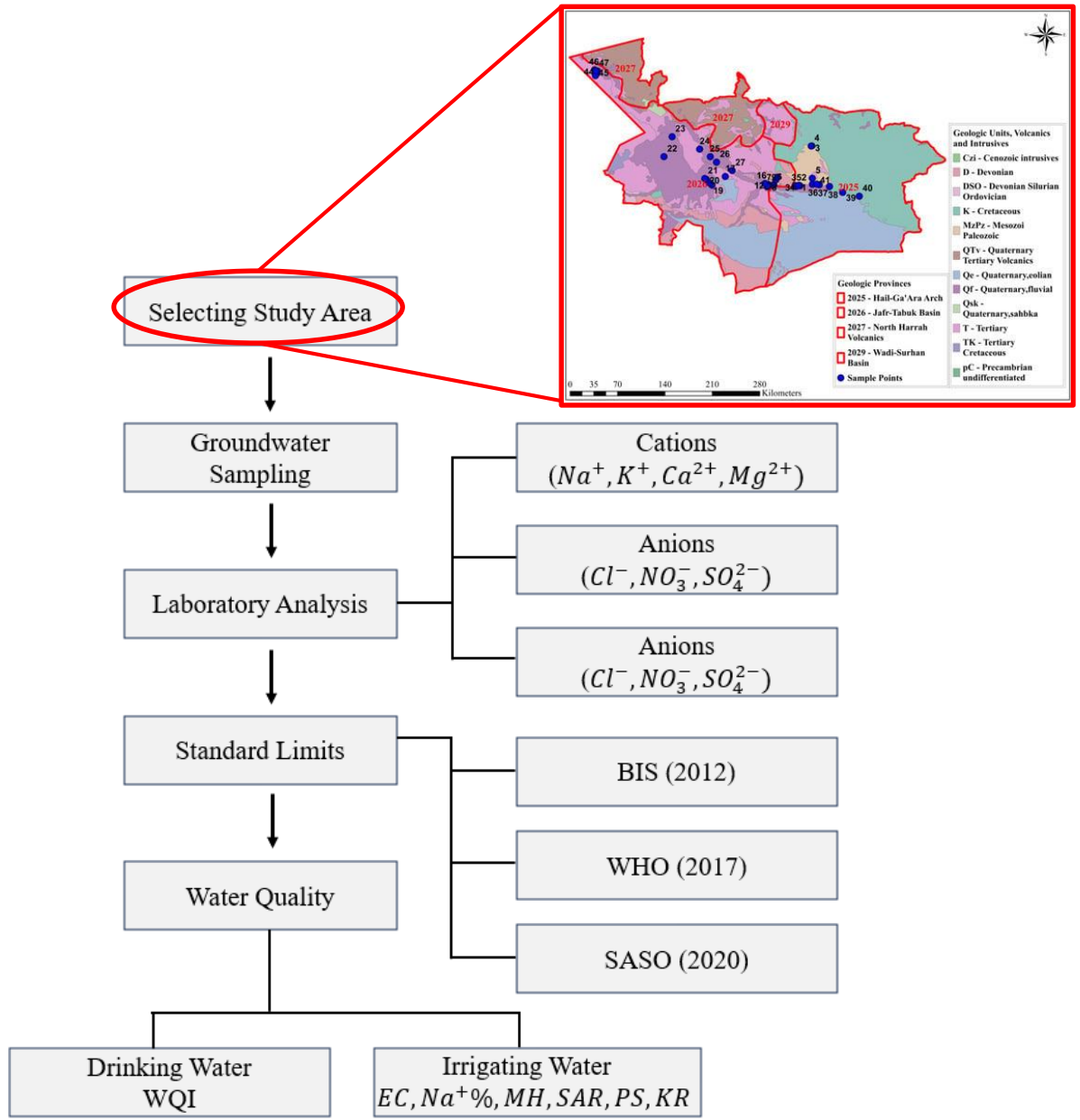
- Al-Jouf faces rising water demand and agriculture expansion, needing urgent groundwater quality assessment.
- The study evaluates key groundwater parameters against standards, utilizing statistical methods.
- Al-Jouf's geology includes diverse formations like the Sirhan Formation and Harrat al Harrah strata.
- Diverse dune formations and alluvial deposits characterize the region.



Methodology

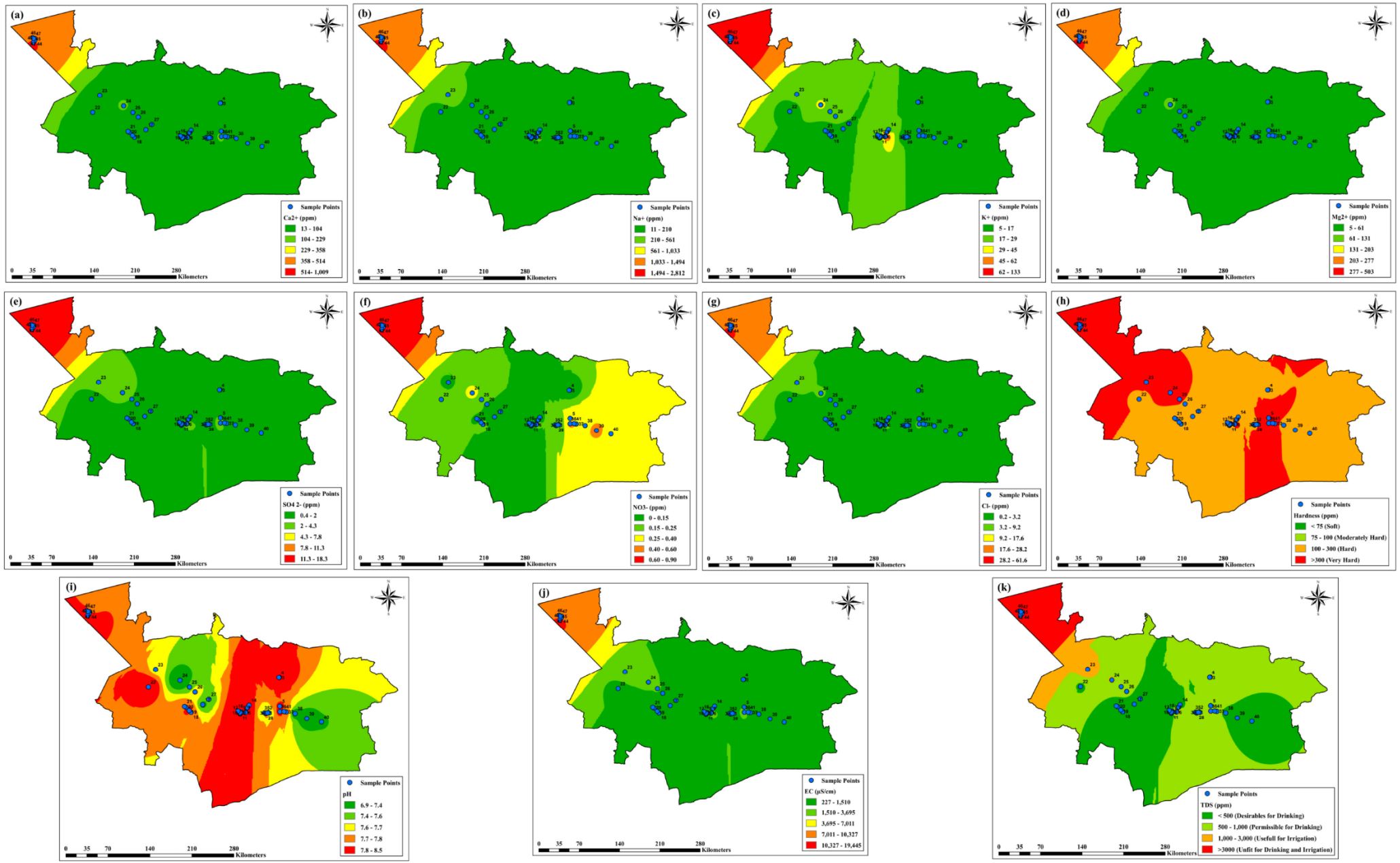
- Al-Jouf farm groundwater samples: collection and storage.
- Water samples analyzed for cation and anion concentrations.
- WQI for drinking water quality calculated using standards.
- Groundwater suitability for irrigation assessed using key parameters.

  (Na+ %, SAR, MH, KR, and PS)



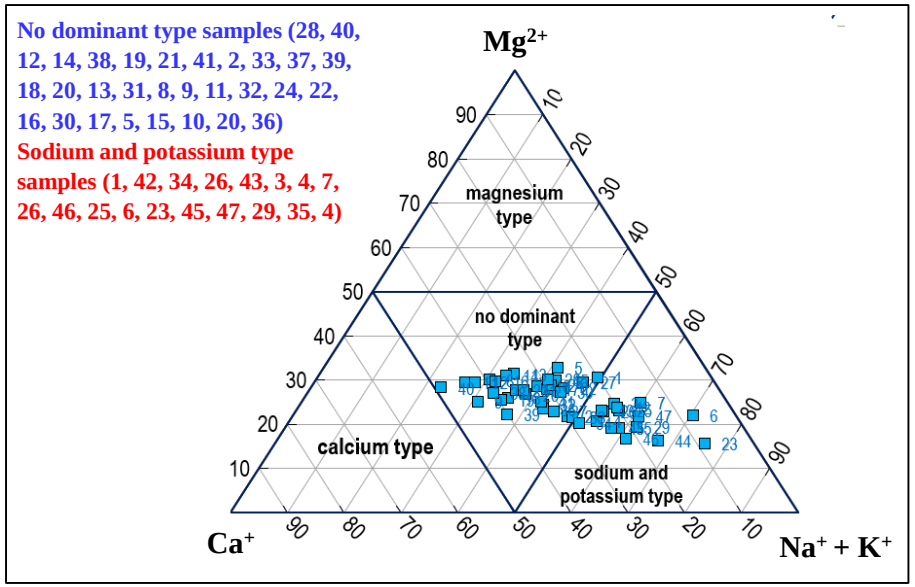
Results

Groundwater Parameter Analysis

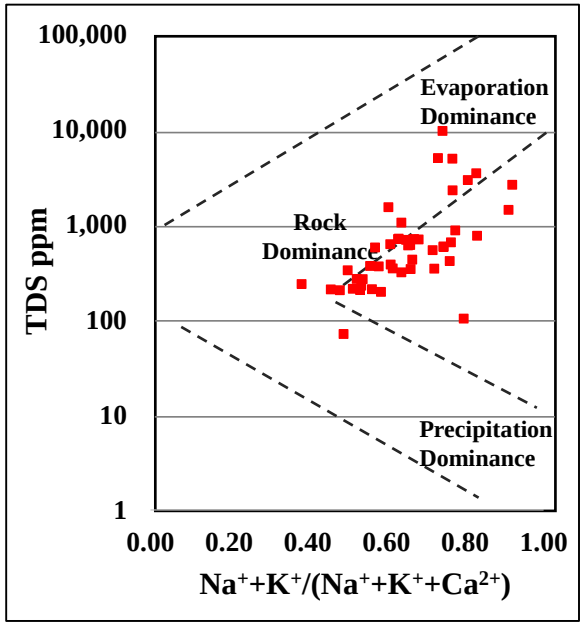


Results

Piper diagram



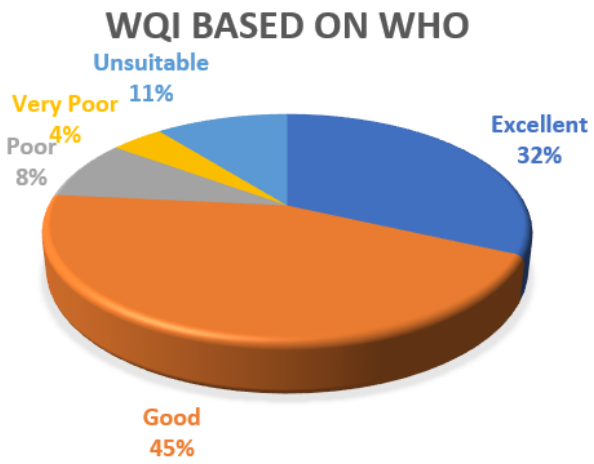
Gibbs plot

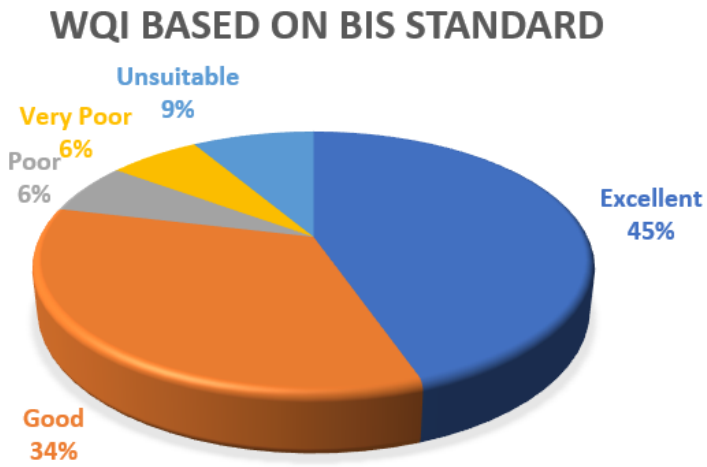


- Samples show water-rock interaction dominance.
- Some samples indicate evaporation domain presence.
- Chemical weathering affects groundwater quality.
- Evaporation domain attributed to environmental and pollution factors.

Results

❖ Assessment of Groundwater Quality for Drinking





- WHO criteria: 31.91% excellent, 44.68% good.
- BIS criteria: 44.68% excellent, 34.04% good.
- Al Qaryat region: WQI > 300, unsuitable.

Results

❖ Assessment of Groundwater Quality for Irrigation

- Irrigation suitability: assessed via EC, Na+ %, MH, SAR, PS, KR.
- EC indicates salt concentrations, salinity risks.
- 83% samples show excellent to good conditions.
- 64% samples meet BIS Na+ % standards.
- MH, influenced by Ca2+ and Mg2+.
- 95.74% samples have suitable MH values.
- SAR: 36.17% excellent, 23.40% good, 21.28% high.
- PS: 63.83% excellent to good.
- KR: 48.94% suitable for irrigation.

Parameter	Range	Classification	Number of Samples	Percentage of Sample (%)
EC µS/cm	<700	Excellent	17	36.17
	700–3000	Good	22	46.81
	>3000	Fair	8	17.02
Na^+ %	<20	Excellent	0	0.00
	20–40	Good	3	6.38
	40–60	Permissible	27	57.45
	60–80	Doubtful	15	31.91
	>80	Unsuitable	2	4.26
MH	<50	Excellent	45	95.74
	>50	Unsuitable	2	4.26
SAR	<10	Excellent	17	36.17
	10–18	Good	1	23.40
	18–26	Doubtful	9	19.15
	>26	Unsuitable	10	21.28
PS	<3	Excellent to good	30	36.17
	3–5	Good to injurious	7	23.40
	>5	Injurious to Unsuitable	10	21.28
KR	<1	Excellent	23	48.94
	>1	Unsuitable	24	51.06

Conclusion

- Most groundwater samples are suitable for drinking and irrigation, except those from the Al Qaryat region.
- According to WHO and BIS standards, a significant portion of the samples meet the criteria for good or excellent drinking water quality.
- The prevalent ions in the samples are ordered as $Na^+ > Ca^{2+} > Mg^{2+} > K^+$ for cations and $Cl^- > SO_4^{2-} > NO_3^-$ for anions.
- The Piper and Gibbs diagrams support these findings and highlight the influence of rock-water interaction processes.
- For irrigation, most samples exhibit excellent to good levels for parameters like EC, Na^+ %, and MH, although SAR, PS, and KR values vary.

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Thank You