

# RB-IWQI: A Risk-Based Approach to Assess Irrigation Water Quality

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# Abstract

This study introduces a novel irrigation water quality index (IWQI). Incorporating regional criteria and decision-maker preferences, it offers improved accuracy over traditional IWQI. Applied to 61 wells in Khoy, Iran, the index identified moderate to high irrigation restrictions, emphasizing the value of customized assessments for sustainable water management.



**Image 1**  
A farm

# Introduction

## Adaptive Water Quality Assessment

Groundwater is crucial for irrigation. Traditional water quality indices often fail to account for regional variations and decision-makers' risk preferences. The goal is to introduce a novel index to integrate MCDM methods and a traditional WQI (IWQI) to provide a more adaptive and precise index.



**Image 2**

A farm irrigates using groundwater from well

# Background

## Irrigation Water Quality Index (IWQI)

IWQI is specifically designed to evaluate irrigation water.

$\text{Na}^+$ ,  $\text{Cl}^-$ ,  $\text{HCO}_3^-$ , EC, and SAR are some of the most important parameters for water quality.

It provides a single value that allows for classifying underground water wells in the desired area.

IWQI	Water use restrictions
$85 \leq 100$	No restriction (NR)
$70 \leq 85$	Low restriction (LR)
$55 \leq 70$	Moderate restriction (MR)
$40 \leq 55$	High restriction (HR)
$0 \leq 40$	Severe restriction (SR)

# Background

## Analytic Hierarchy Process (AHP)

AHP is a MCDM method for evaluating complex decisions involving multiple criteria.

AHP is based on the concept of pairwise comparisons.

decision-making often requires comparing elements in pairs and determining their relative importance.

	Na <sup>+</sup>	Cl <sup>-</sup>	HCO <sub>3</sub> <sup>-</sup>	EC	SAR	Calculated Criteria Weights
Na <sup>+</sup>	1	1	1/3	1/2	1/4	0.09
Cl <sup>-</sup>	1	1	1/2	1/2	1/4	0.1
HCO <sub>3</sub> <sup>-</sup>	3	2	1	1	1	0.25
EC	2	2	1	1	1/2	0.2
SAR	4	4	1	2	1	0.35
						CR = 1.2%

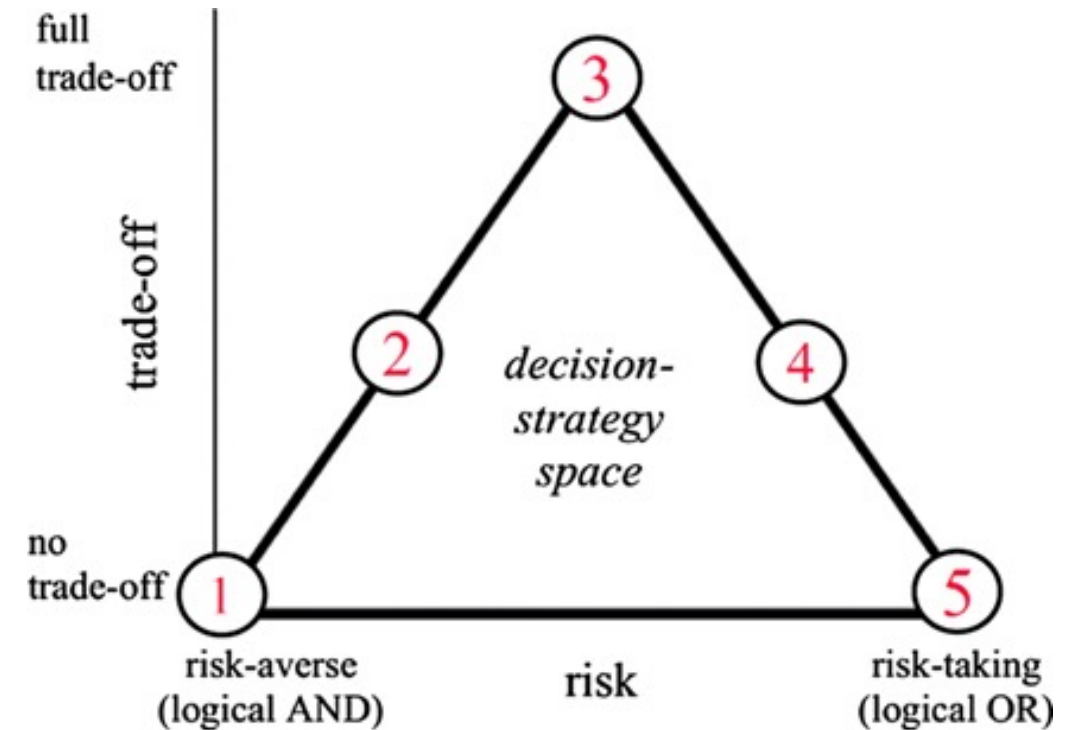
# Background

## Ordered Weighted Averaging (OWA)

A risk spectrum ranging from risk aversion to risk-taking.

Criteria weights are derived from AHP for each criteria and after that ordered weights are assigned.

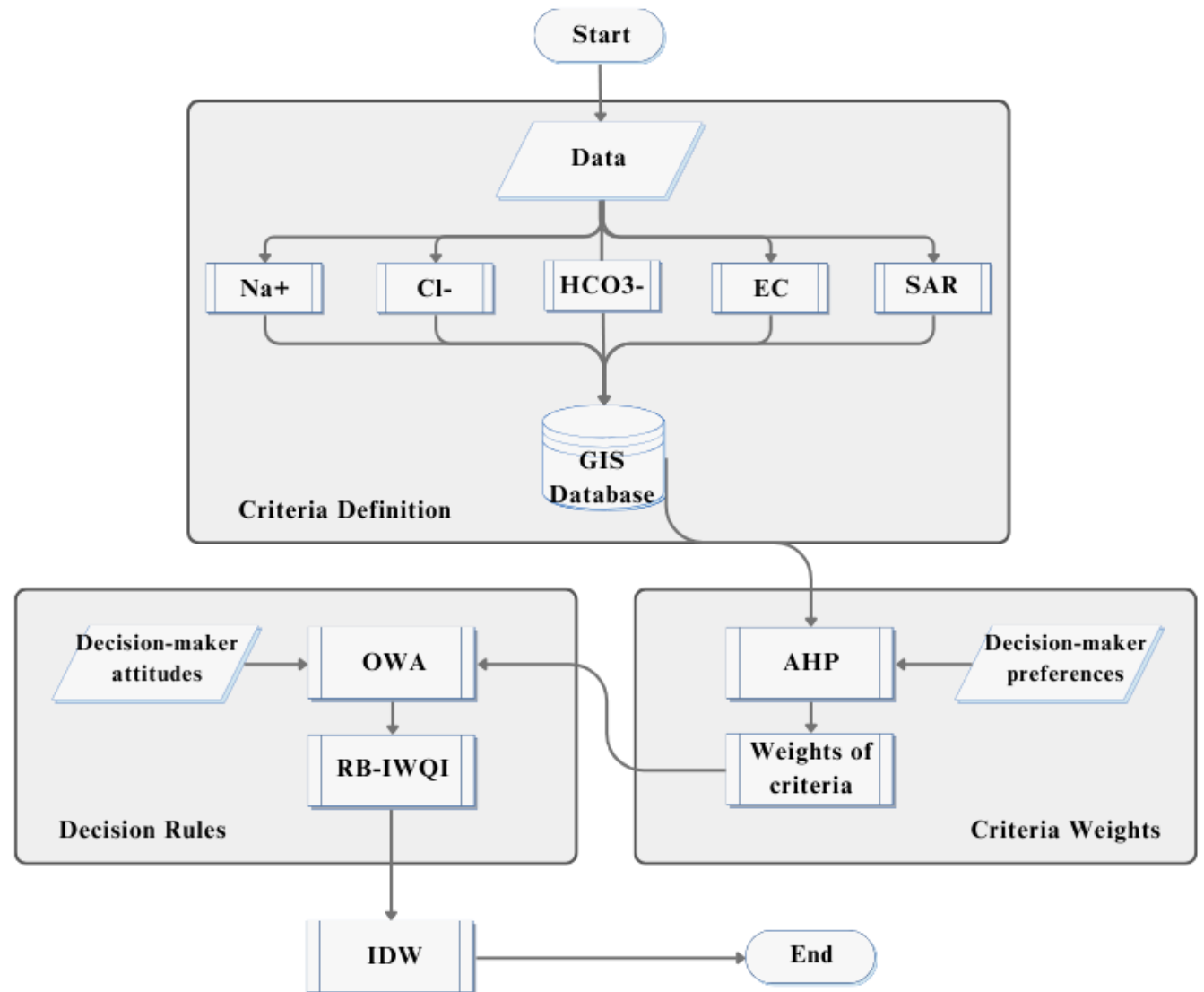
OWA assigns the weights based on their ordering and combines multiple criteria into a single score.



# Methodology

## Tailored Decision-Making

- Criteria Definition
- Criteria Weighting
- Decision Rules
- Spatial Visualization



**Diagram 1**

The methodology diagram of RB-IWQI



# Study Area

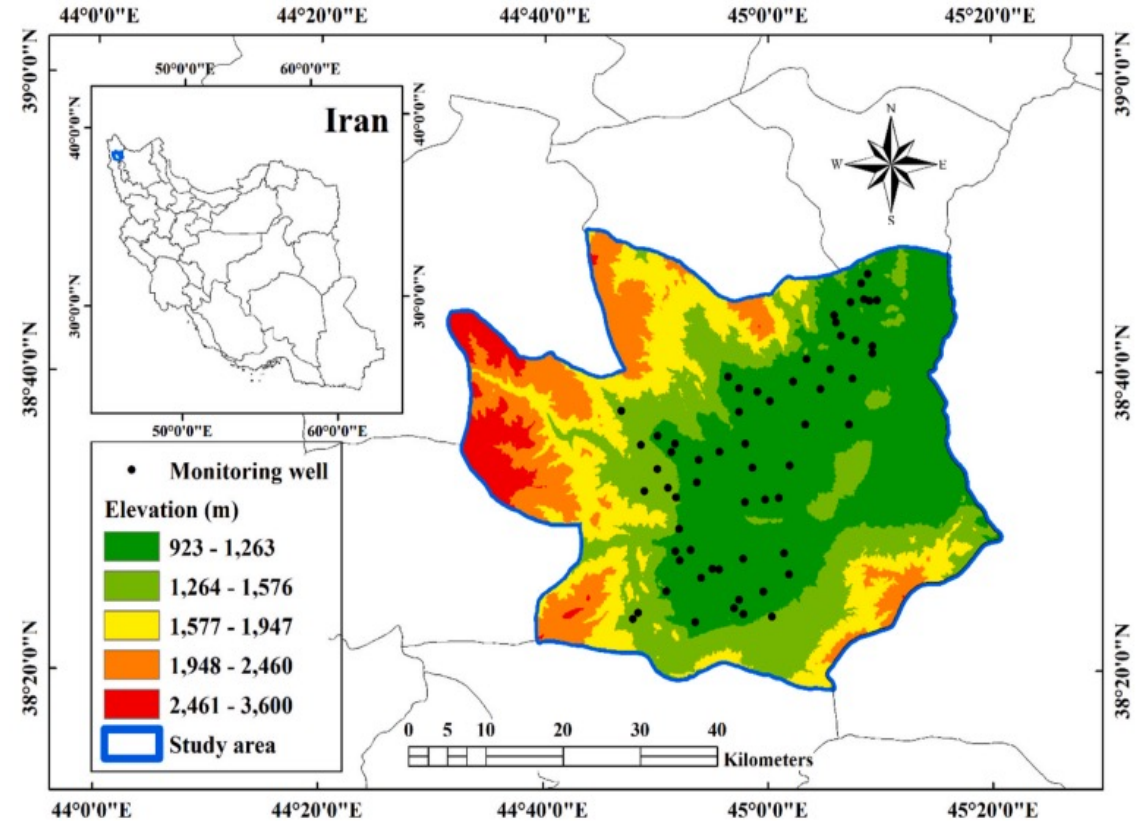
## Critical Region for Irrigation in Iran

The study was conducted in Khoy, Iran.

Its dependence on agriculture and semi-arid climate make effective water management essential.

The area experiences an average annual precipitation of 293 mm.

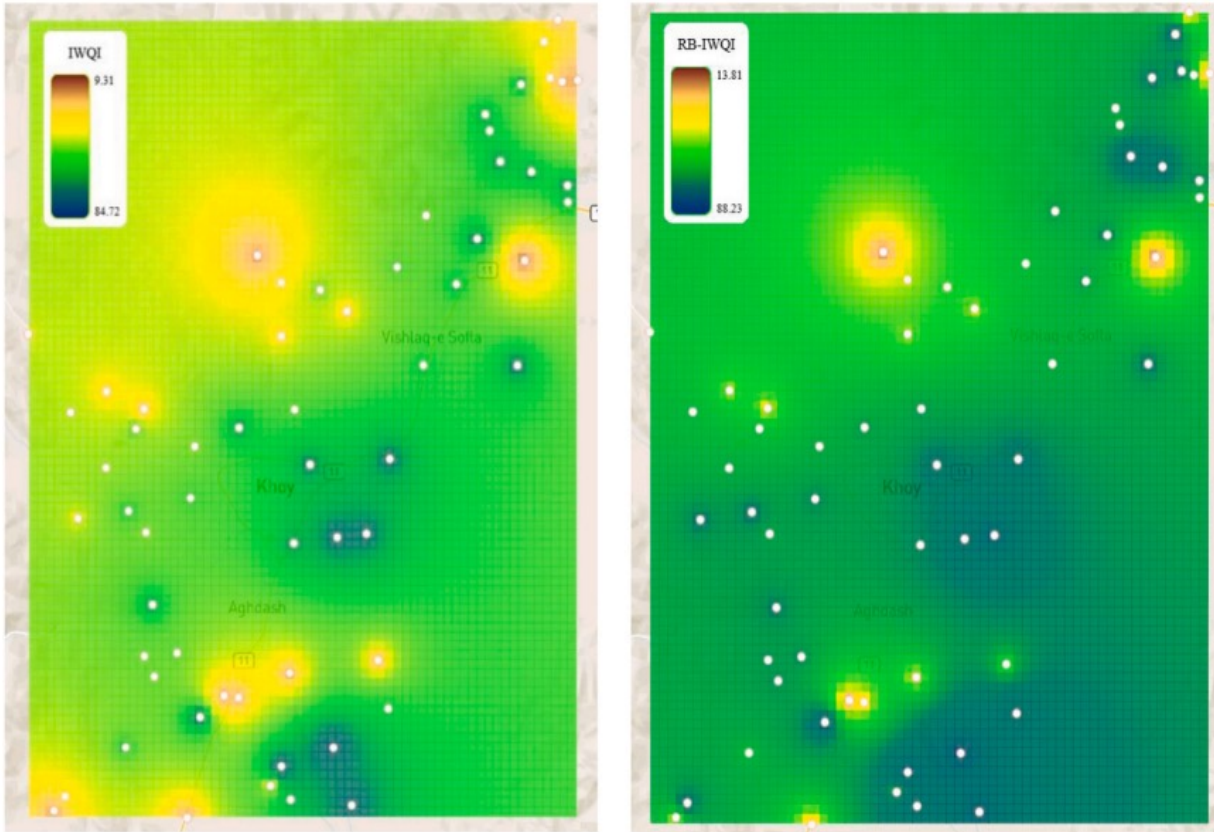
Water samples from 61 wells were collected and analyzed.



**Map 1**  
Study area map



# Results



- **Water Quality Classification:** Most wells show moderate to high irrigation restrictions.
- **Improvement:** Severe restrictions dropped from 10 to 6 wells, showing the value of regional adaptation. Regional
- **Distribution:** Restricted wells cluster in high-demand agricultural areas.

# Conclusions

- Integrating regional-specific criteria and decision-maker preferences into groundwater quality indices significantly improves the accuracy and relevance of irrigation water assessments.
- In regions like Khoy, Iran, the adapted irrigation water quality index effectively identifies groundwater restrictions, providing critical insights for sustainable irrigation practices.

# Questions



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