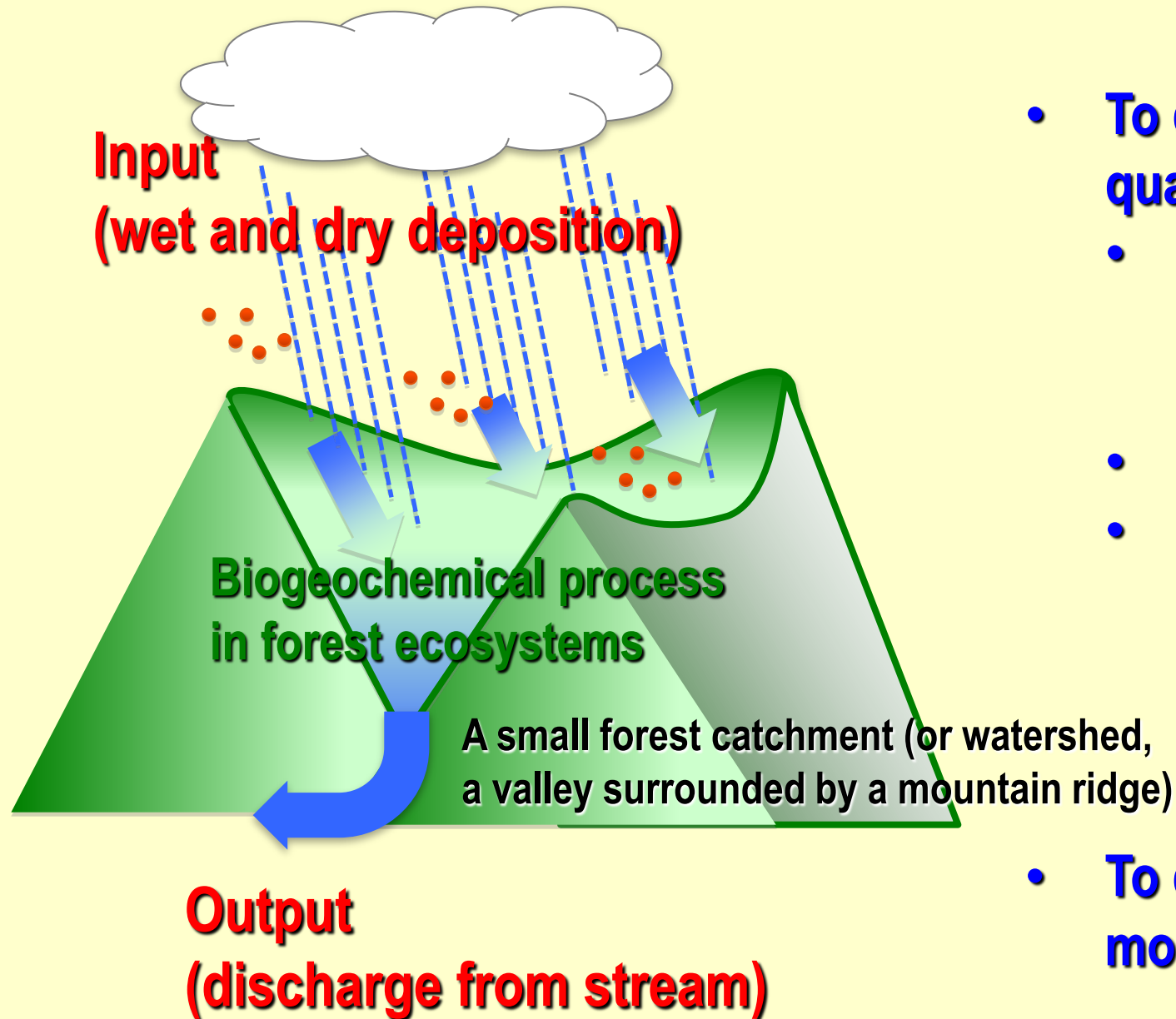


Data Report 2025 (Draft)

Chapter 7: Catchment-scale Monitoring

Network Center for EANET

Catchment-scale analysis may allow us ...



- To discuss qualitatively quantitatively
 - relationship between atmospheric deposition and stream water chemistry
 - Input – output budget
 - Biogeochemistry in the catchment
- To develop the biogeochemical model for evaluation/projection

Monitoring sites:

Table 7.3 Site for the catchment-scale monitoring

Country	Site name (and name of river/stream)	Catchment area (km ²)	Geology and soil type	Coverage of forest (%)	Start year
Japan	Lake Ijira Catchment (Kamagatani River)	2.98 at Kamagatani River	Chert Cambisols (brown forest soils)	99.6%,	November 2007 (the water year here: from November to the next October)
Philippines	La Mesa Watershed (LMW) (Stream at Tower 1 Station)	0.186 at Tower 1	Clastic and volcanic rocks, Loamy-sand soil at Tower 1	68.2% (for the whole LMW)	January 2019

Monitoring sites:

Table 7.4 Survey outline for the catchment-scale monitoring

Site	Items	Detailed items
Lake Ijira Catchment	Input (total deposition)	1. Precipitation amount (at 3 different slope positions) 2. Wet deposition: Ijira 3. Dry deposition (Air concentration measurement for Inferential method): Ijira 4. Total deposition (calculated as wet+dry)
	Output (chemical discharge from the stream)	1. Water discharge (by H-Q curve method) 2. Stream water chemistry: biweekly 3. Chemical discharge
	Soil^{*2}	Soil chemical properties: Lake Ijira
	Vegetation^{*2}	1. Plant growth: Lake Ijira 2. Species composition: Lake Ijira

Monitoring sites:

Table 7.4 Continued

Site	Items	Detailed items
La Mesa Watershed	Input (total deposition)	1. Precipitation amount (1st, PAGASA - Science Garden; 2nd, Manila Observatory) 2. Wet deposition: Metro Manila 3. Dry deposition (Air concentration measurement for Inferential method): Metro Manila 4. Total deposition (calculated as wet+dry)
	Output (chemical discharge from the stream)	1. Water discharge: (using the Float method) 2. Stream water chemistry: monthly 3. Chemical discharge: not determined yet
	Soil ^{*2}	Soil chemical properties: La Mesa Watershed
	Vegetation ^{*2}	1. Plant growth: La Mesa Watershed 2. Species composition: La Mesa Watershed

Results of monitoring:

Table 7.5 List of the dataset submitted for Data Report 2025

Site	Items	Detailed items	Water years
Lake Ijira Catchment	Input	1. Precipitation amount (at 3 points)	2024-2025
	Output	1. Water discharge 2. Stream water chemistry: biweekly 3. Chemical discharge	2024-2025
La Mesa Watershed	Input	1. Precipitation amount	2025
	Output	1. Stream water chemistry: monthly	2025

Table 7.6a Water balance in the catchment: Lake Ijira Catchment

Fluxes ^{*1}	Points	Water year ^{*2}
		2024-2025
Input by precipitation, mm y ⁻¹	Akatani (260 m)	2887
	Ijira monitoring site (140 m)	2935
	Lakeside (110 m)	2641
	Mean	2821
Output by the stream, mm y ⁻¹	Outlet of Kamagatani River	2602
Runoff rate, %		92

Note. ^{*1}, Fluxes were calculated based on the catchment area, 2.98 km⁻², at the outlet of Kamagatani River; ^{*2}, The water year: from November to the next October.

Table 7.7a: Stream water chemistry (biweekly data)

Table 7.8: Periodic chemical discharges from the stream
(biweekly data)

Table 7.8: Annual chemical discharges from the stream

Table 7.6b Water balance in the catchment: La Mesa Watershed

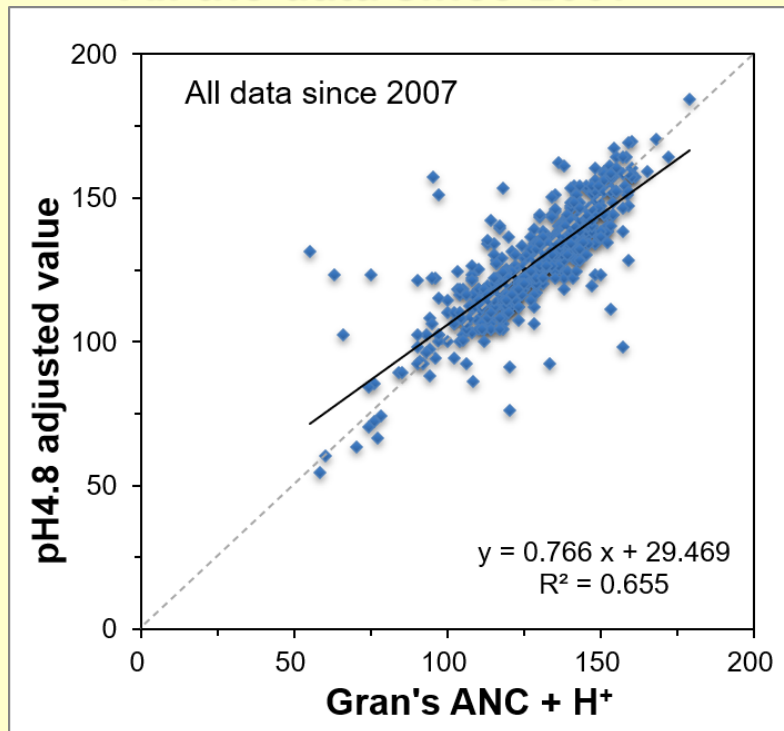
Fluxes ^{*1}	Points	Year
		2025
Input by precipitation, mm y ⁻¹	Science Garden	
	Manila Observatory	2170
Output by the stream, mm y ⁻¹	Outlet of Tower 1	
Runoff rate, %		

Note. ^{*1}, Fluxes were calculated based on the catchment area, at the outlet of Tower 1 Stream; ^{*2}, Average flow in April and December 2019: 0.0231 m³ s⁻¹

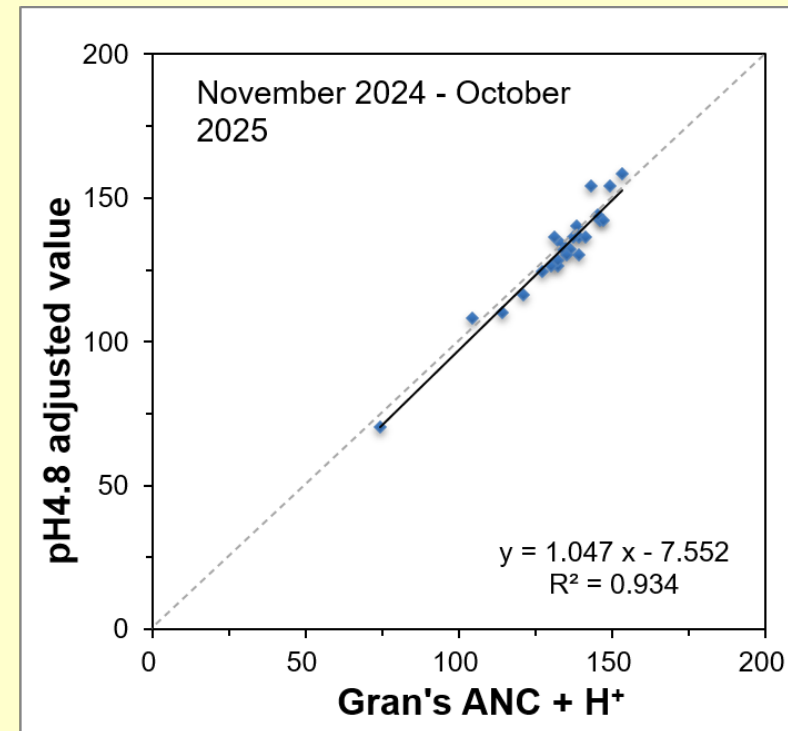
Table 7.7b: Stream water chemistry (monthly data)

Analytical precision of alkalinity at Lake Ijira

All the data since 2007

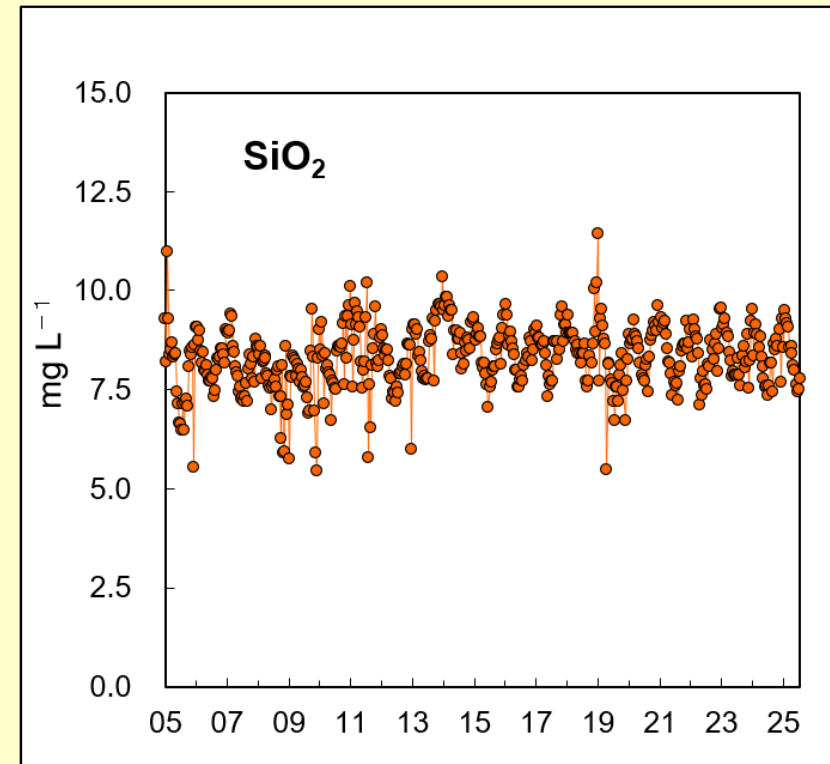
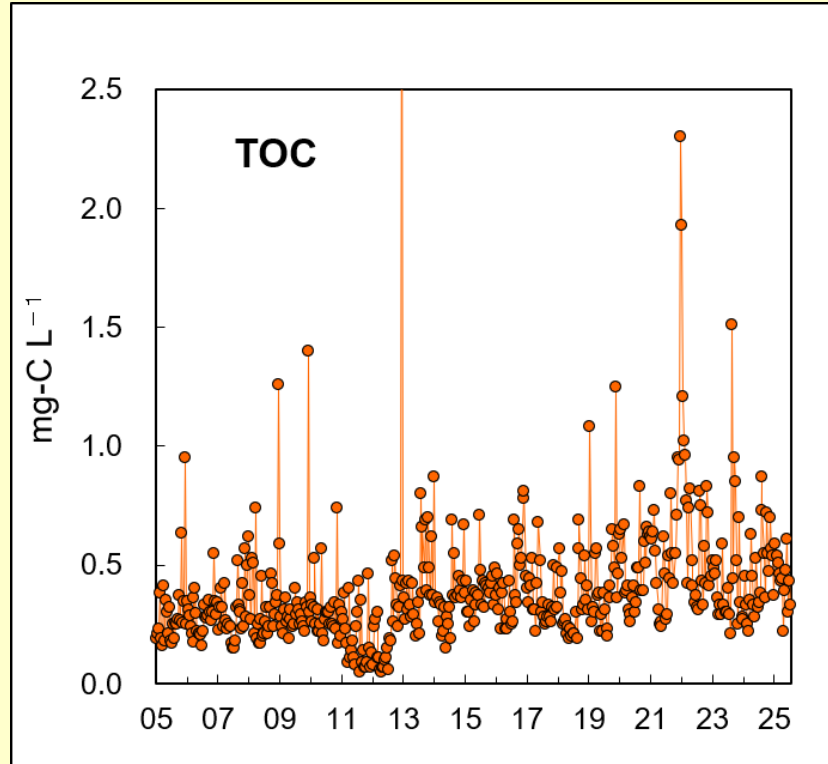


The data in WY2024-2025



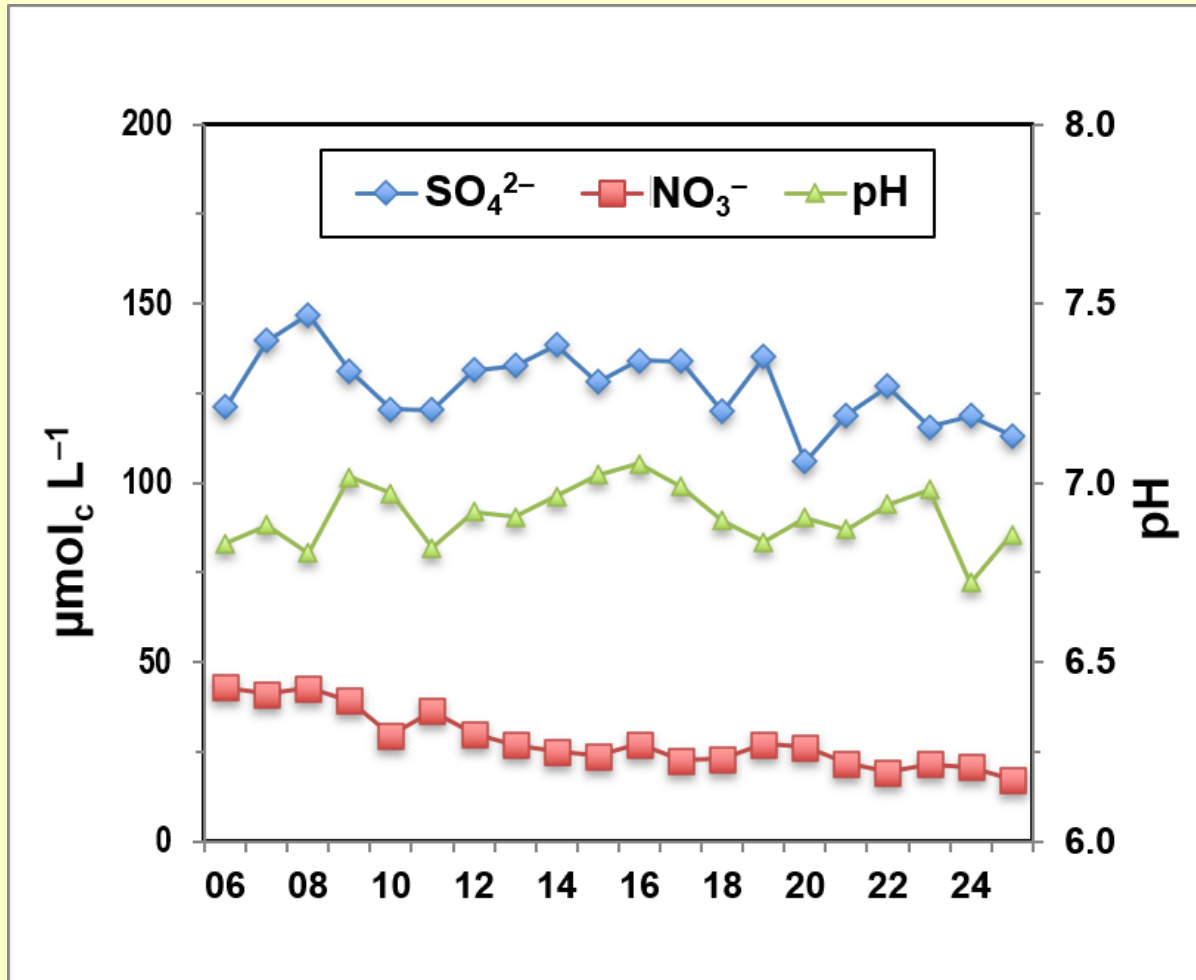
- Analytical precisions of Gran's ANC and pH4.8 alkalinity were generally good (but slightly lower in pH4.8, suggesting effects of organic ions). This tendency may be associated with the long-term increase in TOC concentrations observed in the catchment (see next slide).

Long-term changes in total organic carbon (TOC) and silicate (SiO_2) at Lake Ijira (2005-2025)



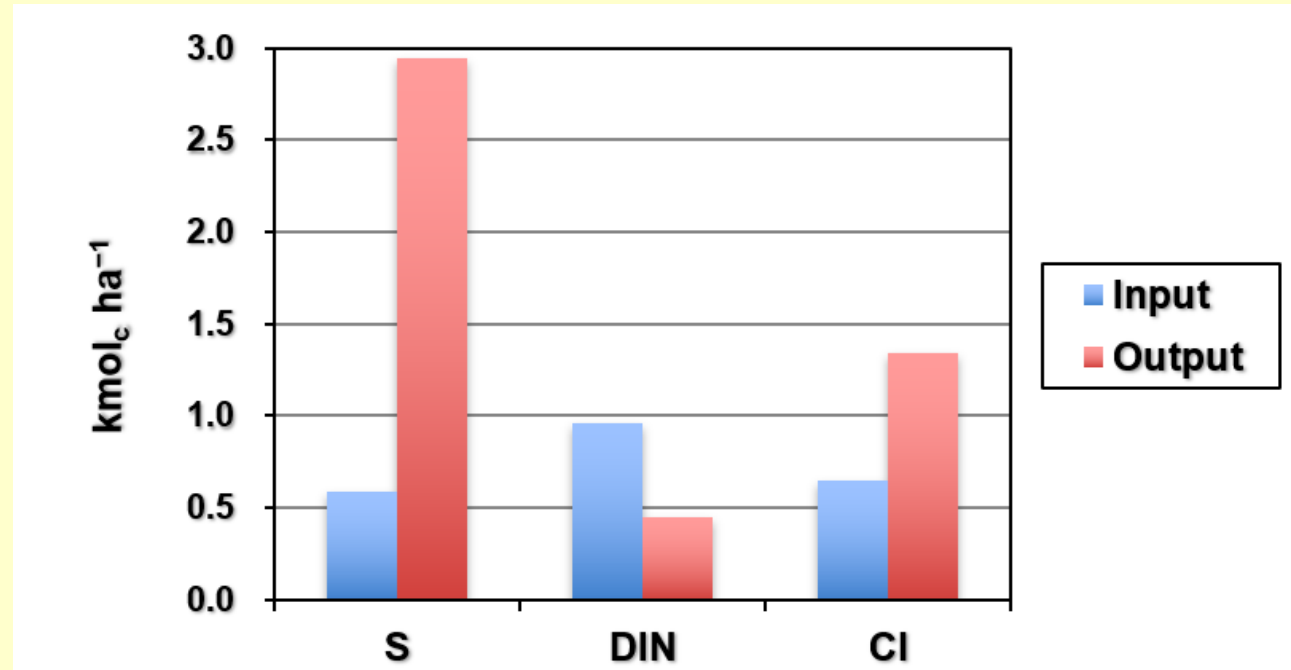
- TOC concentrations showed a significant increasing trend (Mann-Kendall test, $p < 0.001$).
- SiO_2 concentrations showed a slight but significant decreasing trend since 2013 ($p < 0.05$).
- These results may be consistent with continuing recovery from acidification in the catchment.

Weighted mean of the stream water chemistry at Lake Ijira



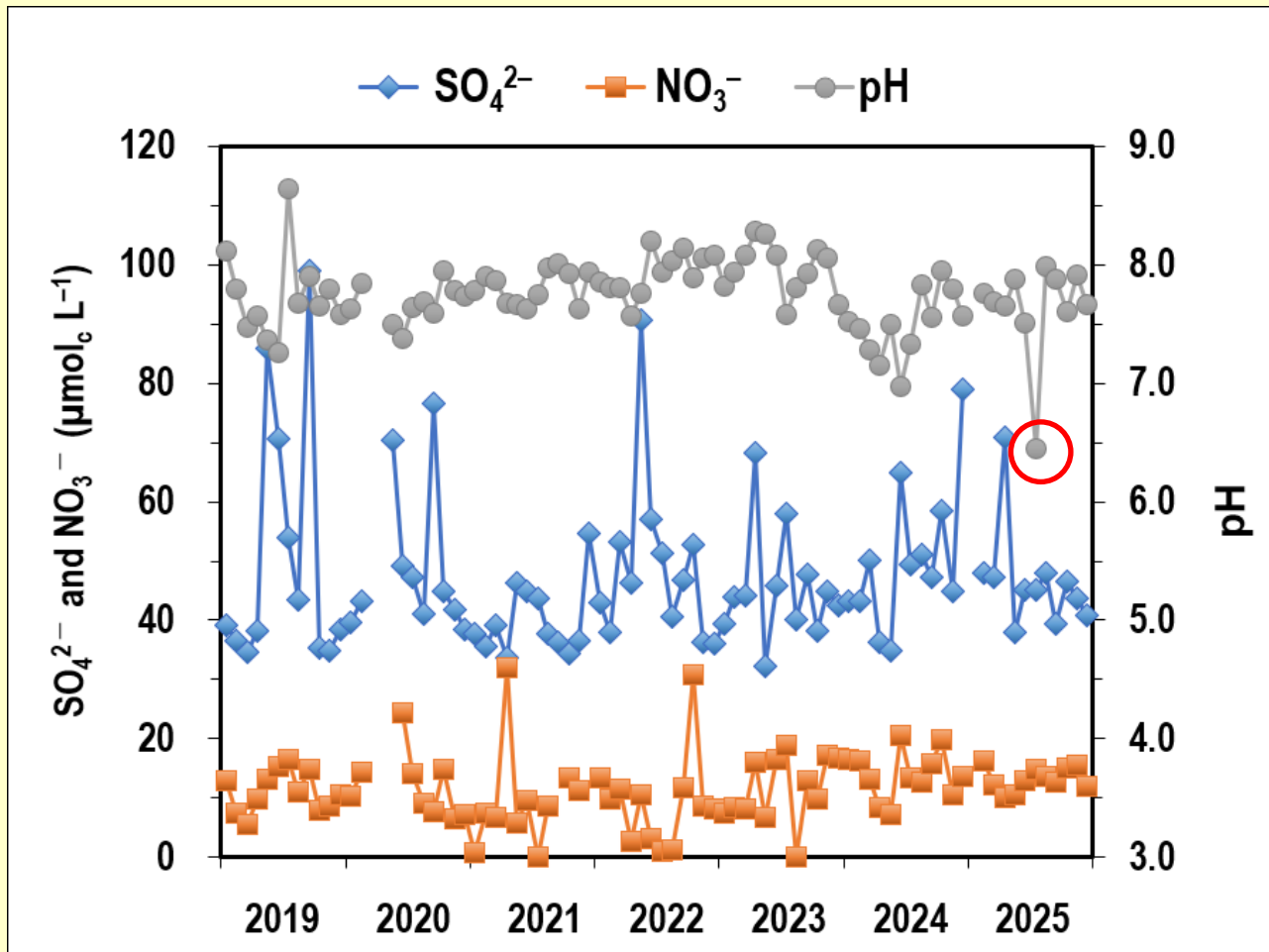
- Nitrate concentrations showed a significant decreasing trend ($p < 0.001$), suggesting a gradual reduction in nitrogen saturation.
- Sulfate concentrations also decreased significantly ($p = 0.015$), whereas no significant long-trend was detected for pH.

Comparison with the inputs (wet + dry) at Lake Ijira WY2023-2024 (based on Data Report 2023 and 2024)



- Sulfur (S) output exceeded the input due to contribution of geology (rock S) (Sase et al. 2019, Biogeochemistry).
- Although dissolved inorganic nitrogen (DIN) output was lower than the input, nitrogen export from the catchment was still evident, indicating continued nitrogen losses from the ecosystem.

Monthly variations of the stream water chemistry at La Mesa Watershed (2019-2025)



- Nitrate (NO_3^-) concentrations showed a significant increasing trend (Mann-Kendall test, $p < 0.05$), whereas no significant long-term trend was detected for sulfate (SO_4^{2-}) concentrations.
- The pH declined to **6.45** in July 2025, accompanied by lower alkalinity and reduced concentrations of base cations (Ca^{2+} and Mg^{2+}).

Long-term trends in stream water chemistry at La Mesa Watershed



Mann-Kendall trend analysis

Variable	τ	Z	p-value	Trend
NO_2^-	0.249	3.74	< 0.001	Upward
NO_3^-	0.161	2.08	0.038	Upward
K^+	0.245	3.23	0.001	Upward
SO_4^{2-}	0.110	1.45	0.147	n.s.
pH	0.023	0.29	0.769	n.s.
EC	0.003	0.04	0.967	n.s.
Alkalinity	-0.118	-1.55	0.120	n.s.

- NO_2^- , NO_3^- and K^+ showed significant increasing trends during 2019-2025.
- No significant trend was detected for pH, EC, alkalinity, or SO_4^{2-} .

Seasonal analysis of stream water chemistry at La Mesa Watershed



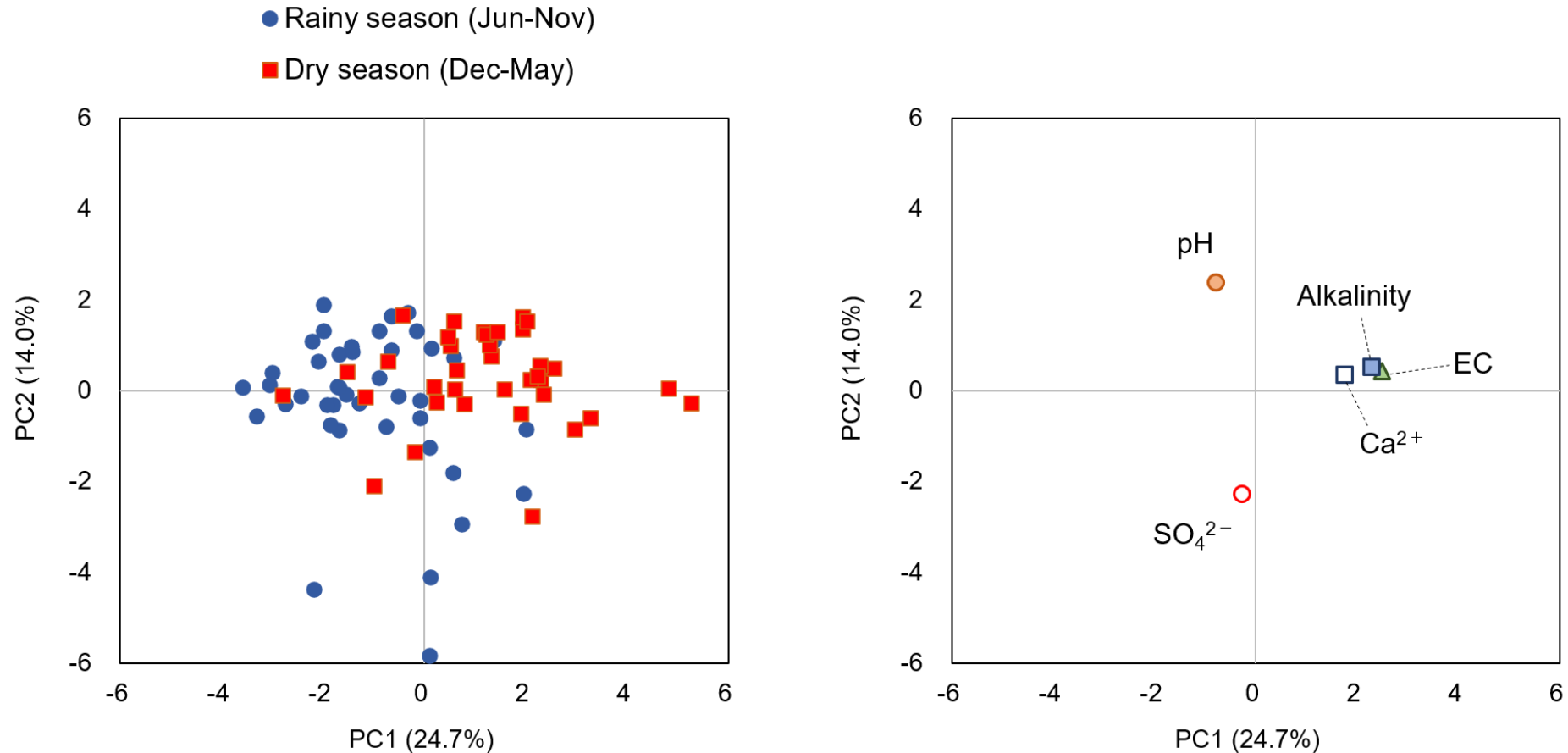
Rainy season (Jun-Nov) vs. **Dry season** (Dec-May)

Variable	Rainy	Dry	p-value
EC (mS m^{-1})	22.3	27.9	< 0.001
Alkalinity (meq L^{-1})	2.39	2.99	< 0.001
Na⁺ ($\mu\text{mol L}^{-1}$)	561	716	< 0.001
Ca²⁺ ($\mu\text{mol L}^{-1}$)	1060	1323	0.009
Mg²⁺ ($\mu\text{mol L}^{-1}$)	713	840	< 0.001
SO₄²⁻ ($\mu\text{mol L}^{-1}$)	45.1	41.7	0.042

Statistical analysis: Mann-Whitney U test

- **EC, alkalinity, Na⁺, Ca²⁺, and Mg²⁺ were higher during the dry season, whereas SO₄²⁻ concentrations were significantly higher during the rainy season (Mann-Whitney U test, $p < 0.05$).**

Principal Component Analysis (PCA) of stream water chemistry at La Mesa Watershed



- Dry-season samples tended to be associated with higher EC, alkalinity and Ca^{2+} concentrations. Seasonal separation was observable but not distinct.

Verification of the data

- **All data were verified by the Ad-hoc Data Verification Group.**
- **No major problems, reference errors, or inconsistencies were identified in the 2025 dataset.**
- **The reviewers emphasized the scientific value of the long-term stream-water dataset and recommended continued monitoring of nitrate seasonality and long-term chemical trends.**

Thank you for your attention