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ASSESSMENT OF THE WATER QUALITY AND SEASONAL VARIATION USING PHYSICOCHEMICAL PARAMETERS FROM SELECTED DAMS AND WATER PANS IN WEST POKOT COUNTY, KENYA

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Abstract

West Pokot County lies within the arid and semi-arid regions of Kenya, with the area experiencing erratic annual rainfall, high temperatures hence prone to high evaporation rates. Water resources in the area are not well developed, and as a result, the county faces frequent incidents of water scarcity and pollution. This study aimed to evaluate the potability of water by assessing temporal and spatial variation of physicochemical parameters in three dams (Siyoi Muruny, Nakuyen and Sook) and three water pans (Pampa, Kitalakapel and Limangole) from four sub-counties of West-Pokot county. Samples of water were collected during wet and dry seasons of 2025; Apri and November respectfully and transported in ice boxes to the lab for analysis using standard AOAC procedures after in situ measurements had been taken using respective portable parameters. Water quality index (WQI) was calculated using the Weighted Arithmetic Index Method (AIM). The results were then analyzed descriptively and statistically by use of one-way ANOVA and t-test to find both temporal and spatial variabilities as well as significant differences ($p \leq 0.05$) and a comparison made with the set standards by World Health Organization (WHO). The pH (4.0-7.9) revealed seasonal variability with high acidity during the dry season at Nakuyen (4.0) and Pampa (5.0) indicating intense organic matter decomposition and reduced buffering. Water temperature were lower during the wet season (12.8 °C–31 °C) and specifically, Kitalakapel Pan (15.02 ± 2.33 °C) and highest at Pampa Pan (21.38 ± 1.83 °C). During the dry season, temperatures increased with Pampa Pan recording highest (29.02 ± 1.73 °C) probably due to increased solar radiation, reduced inflow, and higher evaporation rates which influences many physical, chemical, and biological processes in aquatic systems. The WHO does not set a strict universal temperature limit for natural surface waters used for domestic purposes. The WHO does not prescribe a strict health-based guideline value for Electrical Conductivity (EC) in drinking water but UN WWAP (2010) recommends a maximum of 1,000 µS/cm, all wet season values were within recommended limits and lower than dry season which recorded slightly above limit value at Pampa (1005±37.19). Dissolved Oxygen (DO) concentrations were higher during the wet season ranging from 8.50±0.82 to 9.89±0.90. Biochemical Oxygen Demand (BOD)'s recommended levels should be <5 mg/L, the values ranged from 6.30±0.58 to 7.92± 0.78 mg/L during the dry season. The WHO recommends that COD levels be < 50 mg/L to maintain acceptable water quality and it ranged from. 53.96±9.12 to 62.08±5.57 during the dry season. Total Suspended Solids (TSS) was higher during the wet season with values ranging from 37.80±3.70 to 57.94±2.40. Water Quality Index (WQI) values classified all sources as very poor during wet season and unsuitable during the dry season after ranking WQI using 5-point Likert scale. Water pans recorded worse quality than dams ($p < 0.05$). This pollution suggests high anthropogenic influence and floods. It is therefore recommended that proper attention needs to be given to the dams and pans by appropriate authorities as well as continuous monitoring to prevent poor health implication on the households relying on this water for domestic use, livestock and irrigation.

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Introduction

Kenya is classified as a water-scarce country, with renewable freshwater supplies amounting to less than 1,000 cubic meters per capita annually (National Drought Management Authority [NDMA], 2026; United Nations Children's Fund [UNICEF], 2025). Climate change is exacerbating the dire water crisis situation in Kenya as it threatens the availability of safe drinking water, especially in arid and semi-arid land (ASAL) counties like West Pokot County (Deresse, 2023; Mulwa & Fangninou, 2021). This is because droughts dry up the wells and other sources of safe drinking water in the ASAL areas (Chemoiwa & Kipsumbai, 2024; Huho *et al.,* 2023).

In response to water scarcity challenges, the Kenyan government has implemented various strategies aimed at enhancing water security, including the construction of dams and water pans, the promotion of rainwater harvesting and the development of groundwater resources. However, the effectiveness of these interventions is often affected by inadequate infrastructure, population pressure, agricultural expansion and water pollution (Issaka & Ashraf, 2017).

West Pokot is an arid and semi-arid Land (ASALs) where reliable access to water is limited (Ikobe, 2014). Dams and water pans act as critical water resources in the county. These man-made reservoirs are designed to capture and store surface runoff during the rainy seasons, ensuring a steady supply of water during dry periods (Kiringe *et al.,* 2016). Dams are usually built from earth, rocks or concrete and are usually constructed on rivers to store water in a reservoir (Jackson, 2017; Wahlstrom, 2012). According to Kiringe *et al.* (2016), dams serve multiple purposes, including irrigation, livestock watering, domestic use, floods control and even hydroelectric power generation. Water pans, on the other hand, are smaller reservoirs primarily used for livestock and irrigation in rural communities (Kiggundu *et al.,* 2018).

West Pokot County's rugged topography, widespread pastoralism, overgrazing, erratic rain patterns which lead to flash floods leading to surface run-offs and soil erosion, leads to increased sedimentation in water bodies. This sedimentation not only reduces the storage capacity of dams and water pans but also increases turbidity which may go beyond the recommended (World Health Organization [WHO], 2017) levels of 5NTU, thus affecting water quality.

The open nature of these water sources further exposes them to contamination from organic matter, livestock activity, and human-related pollutants (Kipmutai, 2019; Moïse *et al.*, 2019; Nzeve, 2021). Eutrophication due to high levels of phosphates and rising salinity also impair water quality, affecting plant & animal health, especially agro-pastoral areas where irrigation and livestock watering is practiced.

The increasing population pressure in the county has intensified anthropogenic activities, further straining water resources and exacerbating water quality issues. Despite these challenges, there is limited empirical data on the potability of water from the dams and water pans in West Pokot County. The absence of this information leaves the communities dependent on this water sources vulnerable to using polluted water and responsible authorities in the dark on possible pollution mitigation strategies. This study therefore sets to evaluate potability of water from dams and water pans in West Pokot County which will eventually help in policy making in pollution control and water bodies' protection.

Materials and Methods

The Study area chosen was West Pokot County which is situated between longitudes 34° 47' and 35° 49' East and latitudes 1° and 2° north, covering an area of approximately 9,123.3 square kilometers, with a length of 132 kilometers from north to south (West Pokot County, 2023). The county shares borders with Turkana County to the north and northeast, Trans Nzoia County to the south, Elgeyo Marakwet County to the southeast, and Baringo County to the east (Mbugua, 2016; Mosol, 2022; Sitin, 2020).

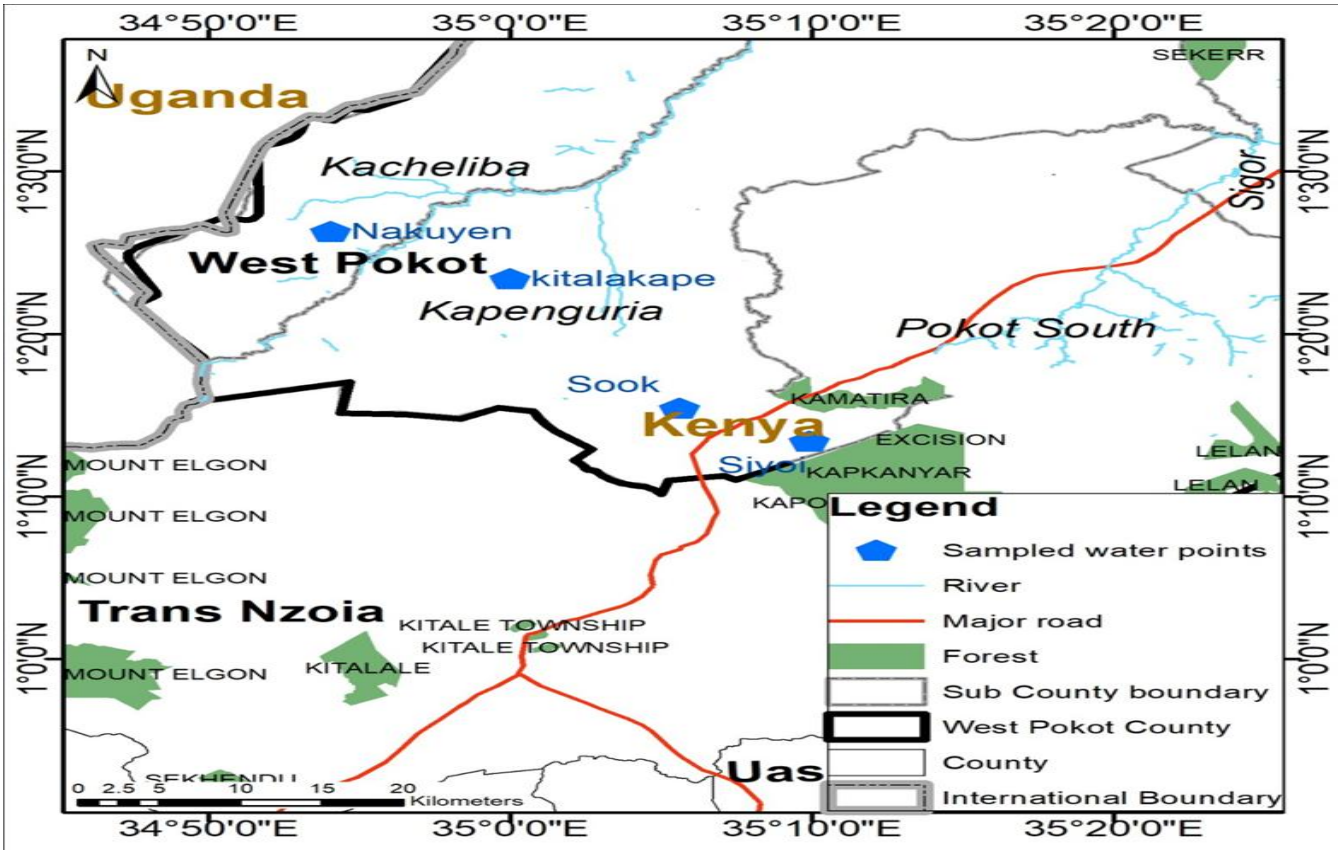
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The county experiences a bimodal rainfall pattern, with long rains occurring between April and August, and short rains between October and February. However, there is significant variation in both the amount and distribution of rainfall across the county. The lowland areas receive about 600 mm of rainfall annually, while the highland areas receive up to 1,600 mm per year (West Pokot County, 2023).

Figure 1

West Pokot County map showing sampled sites



The sites identified were three dams (Siyoi Muruny, Nakuyen, and Sook) and three water pans (Kitalakapel, Pampa, and Limangole) using purposive sampling method. These sites were selected based on proximity to human settlements, agricultural activities and industrial zones as well the size and the time the residents started using the water sources from these water pans and dams. The frequency of sampling was twice, during wet (April) and dry (December) seasons to effectively capture the variations in water quality in the temporal dimensions

Water sampling was through the direct crab method in three locations per water source using clean, pre-rinsed polyethylene bottles to avoid contamination. Each water sample was collected from various depths and locations within the dams and water pans to ensure representativeness.

Analysis of parameters such as pH, temperature, dissolved oxygen (DO), electrical conductivity (EC), and Total dissolved solids (TDS) were measured in-situ using a portable pre calibrated multi parameter (Hanna Instruments HI98194).

The electrical conductivity meter was calibrated using a standard conductivity solution of known value in accordance with the manufacturer's instructions. Conductivity measurements were referenced to 25°C to ensure consistency and comparability among water samples.

The pH meter (Hanna Instruments HI98194) was calibrated using standard buffer solutions of pH 7.00

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and pH 4.00 or 10.00, depending on the expected pH range of the water samples. The electrode was rinsed with distilled water and gently blotted dry between buffer solutions and sample measurements. Calibration was performed according to the manufacturer's instructions, and the electrode was allowed to stabilize before each reading. The pH of the water samples was then measured using the calibrated meter.

For the other parameters, the collected samples were transported to the laboratory in coolers equipped with ice packs to maintain their temperature at 4°C to prevent any changes in their physicochemical properties. The holding time was set for maximum of eight hours, upon arrival at the laboratory, the water samples were allowed to reach room temperature before pretreatment which was done by filtering using Whatman No. 42 filter paper to remove suspended solids and particulates that could interfere with subsequent analyses. The filtrates were collected in clean glass beakers and set aside for analysis.

All readings were taken in triplicate and recorded. Biological Oxygen Demand (BOD) was calculated by measuring the amount of oxygen consumed by microorganisms while decomposing organic matter in a water sample over a five-day period. The procedure involved incubating the samples at 20°C for 5 days in dark conditions to prevent photosynthesis, and then measuring the dissolved oxygen (DO) levels before and after the incubation period. The BOD was determined by subtracting the DO level after 5 days from the initial DO level of the sample. This difference indicated the amount of oxygen required by microorganisms to break down the organic material in the sample, providing a measure of the water's organic pollution level. Chemical Oxygen Demand (COD) was determined using the dichromate reflux method as outlined by Reece (2017). Initially, 10 ml of 0.25 M potassium dichromate ($K_2Cr_2O_7$) and 30 ml of a sulfuric acid (H_2SO_4) and silver sulfate (Ag_2SO_4) reagent were added to 20 ml of diluted water samples, which had been diluted with distilled water. This mixture was refluxed for 2 hours to ensure complete oxidation of organic matter, and then cooled to room temperature. The solution was then diluted to a total volume of 150 ml with distilled water. Excess potassium dichromate was titrated with ferrous ammonium sulfate (FAS), with the titration performed first on a blank sample (A) and then on the water sample (B). The difference in the volume of FAS used between the blank and the sample, multiplied by the normality of FAS (N), and further adjusted for the milliequivalent of oxygen (8), were used to calculate COD using the formula;

$$\text{COD} = \frac{(A-B)\times N\times 100\times 8}{\text{Volume of sample}}$$

Where:

A- Is the ml of FAS used as blank

B- Is the ml of FAS used for sample

N- Is the normality of FAS

8- Is milli equivalent of oxygen

Calculation of water quality index (WQI) was done using the Weighted Arithmetic Index Method (developed by Brown et al., 1972), which combines individual parameter ratings and assigned weights into a single dimensionless number.

The index value for each of the water quality parameters: temperature, pH, BOD, TSS), COD, DO) was calculated. A higher value of each index indicates better water quality.

The WQI was calculated by averaging the individual index values of all the physicochemical parameters for water quality.

The Water Quality Index (WQI) was calculated using the weighted arithmetic method as follows:

$WQI = \Sigma(Q_i \times W_i) / \Sigma W_i$

Where:

Q_i = Quality rating of the ith water quality parameter.

W_i = Relative weight assigned to the ith water quality parameter.

Σ = Summation of all the water quality parameters included in the analysis.

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$$W_i = \frac{w_i}{\frac{n}{\sum_{i=1} w_i}}$$

A quality rating scale (q_i) for each parameter is assigned:

$Qi = (C_i/S_i)$

Where: qi as the rating factor is assigned

Ci= Concentration of each chemical parameter in each sample in mg/l

Si= WHO drinking water standard for each chemical parameter in mg/l

The WQI is calculated by averaging the individual index values of the parameters within the five water quality parameter categories

Collected data were analyzed descriptively using MS Excel spreadsheets and statistical package for social science (SPSS) version 20. Results were presented using means, standard deviations, and graphical representation. Comparison for spatial variations between the six sampling sites was done using one way ANOVA while the independent T- test was used to find the temporal differences between dams and water pans.

Results and Discussion

The recorded pH values ranged from 4.0 to 7.9 across all sampling sites during the study period. During the wet season, most dams showed near-neutral conditions. Nakuyen Dam recorded a mean pH of 7.27 ± 0.19, Sook Dam 7.42 ± 0.43, and Siyoi Muruny Dam 7.17 ± 0.51, all within the recommended limits of the WHO and NEMA guidelines. Among the water pans, Limangole Pan (6.63 ± 0.17) and Kitalakapel Pan (6.70 ± 0.89) also fell within the acceptable range. Pampa Pan recorded a slightly lower mean pH of 6.60 ± 0.42, but it remained within the permissible limit.

During the dry season, greater variability occurred. Sook Dam (7.60 ± 0.21) and Siyoi Muruny Dam (7.62 ± 0.23) remained within the WHO and NEMA recommended limits, indicating stable water chemistry in these reservoirs. Kitalakapel Pan recorded a slightly acidic but near acceptable value of 6.12 ± 0.19, marginally below the recommended lower limit. Limangole Pan (5.88 ± 0.13) and Pampa Pan (5.54 ± 0.46) fell below the recommended pH range, indicating moderately acidic conditions. Nakuyen Dam recorded the lowest mean pH during the dry season (5.32 ± 0.93), with a minimum observed value of 4.0, which falls well below the recommended standards.

The results indicate that most wet season pH values complied with WHO and NEMA guidelines, except in while several dry season measurements in water pans and Nakuyen Dam dropped below the recommended threshold.

Table 1 presents the seasonal temperature values recorded in the dams and water pans during the wet and dry seasons.

Table 1

Seasonal temperature values of water sources

Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Nakuyen Dam	17.42 ± 1.08	28.26 ± 1.79	16.3	30.1
Sook Dam	18.96 ± 1.58	26.78 ± 1.36	17.2	28.1
Siyoi Muruny Dam	15.54 ± 1.34	25.24 ± 1.10	13.7	27.0
Pampa Pan	21.38 ± 1.83	29.02 ± 1.73	19.4	31.0
Limangole Pan	16.08 ± 1.22	24.40 ± 2.39	14.7	28.1
Kitalakapel Pan	15.02 ± 2.33	24.70 ± 2.73	12.8	27.1

The recorded water temperature across all sampling sites ranged from 12.8 °C to 31.0 °C during the study period. During the wet season, temperature values ranged from 15.02 °C to 21.38 °C. The lowest mean temperature occurred at Kitalakapel Pan (15.02 ± 2.33 °C), followed by Siyoi Muruny Dam (15.54 ± 1.34 °C). Nakuyen Dam and Limangole Pan recorded moderate values of 17.42 ± 1.08 °C and 16.08 ± 1.22 °C, respectively. The highest wet season temperature occurred at Pampa Pan (21.38 ± 1.83 °C).

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During the dry season, temperatures increased substantially at all sites. Pampa Pan recorded the highest mean temperature (29.02 ± 1.73 °C), followed by Nakuyen Dam (28.26 ± 1.79 °C) and Sook Dam (26.78 ± 1.36 °C). Most dry season temperatures remained within the typical tropical surface water range (20–30 °C) recommended for healthy aquatic environments according to WHO and NEMA guidance for natural waters. Water temperature influences many physical, chemical, and biological processes in aquatic systems. The WHO does not set a strict universal temperature limit for natural surface waters used for domestic purposes; however, temperatures in tropical freshwater systems commonly range between 20 °C and 30 °C.

Likewise, the WHO does not prescribe a strict health-based guideline value for EC in drinking water but the United Nations World Water Assessment Programme (UN WWAP 2010) (recommends a maximum of 1,000 μS/cm for potable water supplies (AlpHa Measure, 2024). Table 2 presents the seasonal EC values recorded in the dams and water pans during the wet and dry seasons.

Table 2

Seasonal electrical conductivity values

Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Nakuyen Dam	846 ± 20.74	994 ± 17.82	820	1015
Sook Dam	890.6 ± 46.82	982.2 ± 9.34	853	993
Siyoi Muruny Dam	768.2 ± 82.11	976 ± 9.30	697	990
Pampa Pan	864.6 ± 5.41	1005.4 ± 37.2	860	1037
Limangole Pan	861.2 ± 9.47	963.2 ± 42.80	849	1010
Kitalakapel Pan	735.8 ± 92.24	963.2 ± 41.85	630	990

The results show a consistent seasonal increase in conductivity during the dry season relative to the wet season. When compared with the WHO recommended limit of 1,000 μS/cm for potable water, most wet season values fall within the acceptable range. During the dry season, several sites approached or slightly exceeded this guideline. In particular, Pampa Pan (1005.4 μS/cm mean; maximum 1037 μS/cm) and Nakuyen Dam (maximum 1015 μS/cm) exceeded the recommended level.

Dissolved oxygen (DO) represents the amount of oxygen available in water for aquatic organisms and plays a role in biological and chemical processes in aquatic systems. The WHO (2017) recommends that surface water should maintain dissolved oxygen levels above 5 mg/L to support aquatic life and acceptable environmental quality. Table 3 presents the seasonal dissolved oxygen values recorded in the dams and water pans.

Table 3

Seasonal dissolved oxygen values

Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Nakuyen Dam	8.50 ± 0.82	4.76 ± 0.32	4.3	9.4
Sook Dam	9.46 ± 0.99	8.04 ± 0.48	7.3	11.0
Siyoi Muruny Dam	9.89 ± 0.90	7.90 ± 1.02	6.5	11.3
Pampa Pan	6.22 ± 0.37	4.56 ± 0.44	4.0	6.7
Limangole Pan	9.34 ± 0.96	5.58 ± 0.43	4.95	10.6
Kitalakapel Pan	9.88 ± 2.99	5.66 ± 0.60	5.1	13.6

Dissolved oxygen concentrations demonstrate a distinct seasonal trend where levels were higher during the wet season compared to the dry season. All sites-maintained concentrations above the WHO/NEMA recommended minimum of 5 mg/L during the period. In contrast, the dry season saw a decline in oxygen levels at most sites.

Biochemical oxygen demand (BOD) measures the amount of dissolved oxygen required by microorganisms to decompose organic matter in water. The WHO recognizes BOD as a key indicator of organic pollution in surface waters and recommends that BOD concentrations in surface waters used for domestic purposes should generally remain below 5 mg/L. Table

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4 presents the seasonal BOD values recorded in the dams and water pans.

Table 4

Seasonal BOD values

Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Nakuyen Dam	4.22 ± 0.73	7.86 ± 0.75	3.3	8.6
Sook Dam	5.14 ± 0.93	7.92 ± 0.78	4.2	8.8
Siyoi Muruny Dam	2.76 ± 1.39	6.82 ± 0.33	1.1	7.2
Pampa Pan	5.78 ± 0.33	7.26 ± 0.92	5.4	8.1
Limangole Pan	2.58 ± 1.04	6.38 ± 0.41	1.2	6.9
Kitalakapel Pan	2.29 ± 2.65	6.30 ± 0.58	0.1	6.8

The results show a clear seasonal trend, with higher BOD values recorded during the dry season relative to the wet season. The values of four sites fell within the recommended limit of 5 mg/. However, Sook Dam (5.14 ± 0.93 mg/L) and Pampa Pan (5.78 ± 0.33 mg/L) slightly exceeded the recommended threshold, suggesting moderate organic loading at these sites during the wet season. All dry season values exceeded the NEMA recommended limit of 5 mg/L, indicating increased organic pollution during this period.

Chemical oxygen demand (COD) measures the amount of oxygen required to chemically oxidize organic and inorganic substances in water. The WHO (2017) recommends that COD levels in surface waters intended for domestic use should generally remain below 50 mg/L to maintain acceptable environmental water quality. Table 5, presents the seasonal COD values recorded in the dams and water pans.

Table 5

Seasonal COD values

Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Nakuyen Dam	44.8 ± 3.27	59.0 ± 2.92	40	63
Sook Dam	49.3 ± 4.12	58.26 ± 1.37	46.4	59.5
Siyoi Muruny Dam	36.6 ± 8.41	57.5 ± 1.15	28	59
Pampa Pan	46.72 ± 0.65	62.08 ± 5.57	46	68
Limangole Pan	35.62 ± 1.40	53.96 ± 9.12	33.5	61
Kitalakapel Pan	34.00 ± 9.14	56.14 ± 4.63	24	59

The results show a consistent seasonal pattern, with higher COD values recorded during the dry season relative to the wet season. Most wet season values remained below the recommended limit of 50 mg/L, although Sook Dam approached this threshold.

During the dry season, COD values increased across all sampling sites. Pampa Pan recorded the highest mean value (62.08 ± 5.57 mg/L). All dry season values exceeded the recommended limit of 50 mg/L, indicating elevated levels of organic and chemical pollution during this period. Water pans, particularly Pampa Pan, recorded slightly higher COD values than dams, suggesting stronger accumulation of pollutants and limited water circulation in shallow water bodies.

Total dissolved solids (TDS) represent the combined concentration of dissolved inorganic salts and small amounts of organic matter present in water. The WHO (2017) recommends a maximum guideline value of 1000 mg/L for domestic use, above which palatability may decline. Table 6 presents the seasonal TDS values recorded in the dams and water pans.

Table 6

Seasonal TDS values

Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Nakuyen Dam	346 ± 20.74	494 ± 17.82	320	515
Sook Dam	348.2 ± 44.79	466 ± 30.50	300	490

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Water Source	Wet Season Mean ± SD	Dry Season Mean ± SD	Minimum Overall	Maximum Overall
Siyoi Muruny Dam	366 ± 194.50	474.6 ± 10.29	200	690
Pampa Pan	364.8 ± 5.54	512.6 ± 34.00	360	540
Limangole Pan	361.4 ± 9.56	464.2 ± 44.57	349	510
Kitalakapel Pan	235.8 ± 92.24	463.9 ±42.47	130	492.5

Total dissolved solids across the sampled water sources ranged from 130 mg/L to 690 mg/L during the entire study period (wet and dry seasons). The results indicate a clear seasonal pattern, with higher TDS concentrations during the dry season compared with the wet season. These wet season concentrations remained well below the WHO recommended limit of 1000 mg/L, indicating acceptable mineral content.

During the dry season, TDS values increased across all water sources and all measured TDS values remained within the WHO recommended limit of 1000 mg/L for drinking water and surface water intended for domestic use.

Total suspended solids (TSS) represent the concentration of undissolved particles present in water, including silt, clay, organic matter, algae, and other microscopic materials. The WHO recommends that TSS in surface water intended for domestic use should generally remain below 30 mg/L to maintain acceptable environmental quality. Table 7 presents the seasonal TSS values recorded in the dams and water pans.

Table 7

Seasonal TSS values

Water Source	Dry Season Mean ± SD	Wet Season Mean ± SD	Minimum	Maximum
Nakuyen Dam	35.68 ± 6.25	56.38 ± 1.69	28	59
Sook Dam	29.60 ± 6.19	37.80 ± 3.70	20	43
Siyoi Muruny Dam	27.40 ± 6.27	39.60 ± 6.58	18.9	47
Pampa Pan	49.08 ± 2.45	57.94 ± 2.40	46	61
Limangole Pan	29.66 ± 6.41	52.40 ± 2.40	22.7	56
Kitalakapel Pan	27.60 ± 18.08	52.06 ± 3.46	5.7	54.9

The results show a clear seasonal increase in TSS during the dry season relative to the wet season. This is because of higher evaporation in dry season. Pampa Pan recorded the highest mean value (57.94 ± 2.40 mg/L), followed by Nakuyen Dam (56.38 ± 1.69 mg/L). All dry season values exceeded the recommended limit of 30 mg/L, indicating elevated suspended particles during this period. Water pans, particularly Pampa Pan, recorded higher TSS values compared with dams.

Higher TSS levels were observed in water pans compared to dams, particularly at Pampa Pan, which reflect the influence of shallow depth, direct runoff entry, and greater exposure to disturbance in water pans. This observation is supported by Githaiga et al. (2026), who reported that shallow and stagnant rural water bodies in Kenya tend to record elevated suspended solids due to sediment accumulation and limited settling, with TSS values frequently exceeding 50 mg/L in such environments.

The independent samples t-test results show strong seasonal variation in water quality across all study sites, with most physicochemical parameters differing significantly between wet and dry seasons ($p < 0.05$). TDS, DO, BOD, COD, and TSS consistently showed significant differences across nearly all sites, indicating that seasonal processes such as evaporation, runoff, and biological activity substantially influence water quality. While a few parameters like pH (in Sook Dam, Siyoi Muruny Dam, and Kilalakapel Pan) and TDS (in Siyoi Muruny Dam) remained statistically stable, the overall pattern demonstrates that dry seasons are associated with increased pollutant concentration and reduced water quality, particularly in shallow systems like water pans, which respond more rapidly to environmental changes than deeper dam reservoirs. Wet seasons typically increase runoff inputs, transporting sediments, nutrients, and organic matter into water bodies, while dry seasons concentrate dissolved ions due to reduced dilution and higher evaporation rates

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ANOVA results show clear spatial differences in water quality across the six sampling sites, with significant variation in pH, dissolved oxygen, biochemical oxygen demand, and total suspended solids ($p < 0.05$). These differences indicate changes in acidity–alkalinity balance, oxygen availability, organic pollution, and sediment loading among dams and pans, reflecting site-specific environmental and anthropogenic influences. In contrast, temperature, EC, COD, and TDS did not differ significantly ($p > 0.05$), suggesting relatively uniform regional climatic and hydrogeochemical conditions across the study area. Spatial variation in physicochemical water quality across semi-arid aquatic systems reflects strong influence from localized hydrology, catchment disturbance, and evaporative concentration. These results closely mirror the current observation that oxygen-related parameters and pH differ significantly across sites, confirming that localized biological activity, algal productivity, and organic decomposition drive water quality contrasts in ASAL arears, similar findings indicate that high evaporation rates and intermittent inflows intensify ionic concentration and pH fluctuations, especially in shallow endorheic systems.

Dams and water pans show broadly similar physicochemical conditions, but significant differences emerge in dissolved oxygen and total suspended solids, where dams record higher oxygen levels and water pans show higher sediment loads due to depth, mixing, and resuspension effects ($t = 2.226$, $p = 0.030$; $t = -2.182$, $p = 0.033$). The observed differences between dams and water pans reflect how water body morphology and hydrodynamics shape key water quality parameters. Higher dissolved oxygen levels in dams indicate better vertical mixing, greater depth, and reduced temperature-driven oxygen depletion, which together support improved aeration and stabilization of oxygen concentrations. In contrast, water pans tend to be shallow and more exposed, limiting stratification and making them more sensitive to temperature fluctuations and oxygen depletion under high organic loading conditions. Similar patterns are commonly reported in semi-arid systems where reservoirs maintain more stable oxygen regimes than shallow pans due to higher water volume and longer residence time. The higher total suspended solids in water pans reflect greater sediment resuspension and direct disturbance from wind action, livestock access, and surface runoff inputs. Shallow depths allow bottom sediments to be easily re-suspended into the water column, increasing turbidity and reducing light penetration. Dams, on the other hand, allow greater settling of particulates due to deeper water columns and reduced bottom disturbance, resulting in comparatively lower suspended solid concentrations. This contrast highlights the sensitivity of shallow ASAL water pans to physical disturbance and catchment activities, making them more prone to episodic deterioration in water clarity and quality compared to dam reservoirs.

Conclusion and Recommendations

Water pans and dams are a critical source of water to people living in ASALs. It is thus important to monitor the quality of the water stored in the dams to ensure it meets the recommended minimum threshold for potable water.

The findings of this study demonstrate that water quality in the West Pokot County is strongly influenced by seasonal dynamics, with most physicochemical parameters showing significant differences between wet and dry periods. Seasonal shifts are evident in changes in temperature, DO, EC, and indicators of organic pollution, reflecting the combined effects of rainfall, dilution, evaporation, and biological activity. While some parameters such as pH and total dissolved solids remained relatively stable in specific sites, the overall pattern shows deterioration in water quality during the dry season, characterized by reduced oxygen levels and increased organic and suspended pollutant loads. Water pans exhibited more pronounced seasonal fluctuations than dams, indicating higher sensitivity to environmental changes due to their shallow nature.

This study therefore recommends that relevant authorities like NEMA, County Government, community leaders and other non-governmental organizations must strengthen enforcement of buffer zone regulations around dams and water pans to safe distances from water edges, specifically targeting the high-intensity point source activities identified particularly livestock watering which bring about mudding and erosion hence the enhanced pollution especially in areas like

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Pampa water pan where livestock feed nearby and are watered in the pan. This will highly reduce pollution and enhance water safety for the local communities.

Declarations

Declaration of generative AI and AI-assisted technologies in the writing process

The authors, while preparing this work, utilized ChatGPT for spell checking and grammar refinement. After using this AI tool, the authors carefully reviewed and edited the content as necessary and assumed full responsibility for the publication's content.

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CRediT authorship contribution statement

Tarus SJ: Writing – original draft, Methodology, Data curation. Kituyi. L: Writing – review & editing, Conceptualization. Rono.M: Writing – review & editing, conceptualization

Declaration of conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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