Journal of Materials Science and Engineering A 16 (1-3) (2026) 1-11
doi: 10.17265/2161-6213/2026.1-3.001

Influence of Salinity and Conductivity of Brackish Waters on the Chemical Properties of Guinean Mangrove Soils and Their Suitability for Making Earthen Bricks

Labilé Kolie[1], Ibrahima Sory KOUROUMA[2], Alpha Oumar Diallo[3] and Tökpö Ninamou[4]

1. Department of Civil Engineering, Gamal Abdel Nasser University of Conakry, BP 1147, Conakry (CKRY 001), Republic of Guinea

2. Department of Climate Change and Agriculture (Wascal PhD programme), Polytechnic Institute of Training and Applied Research (IPR/IFRA), Katibougou, Koulikoro, BP 06, Mali

3. Laboratory of Ecology and Environment, Institute of Research in Ecology and Environment (IREG), Gamal Abdel Nasser University of Conakry (UGANC), Conakry, BP 1147, Guinea

4. Hydraulics Laboratory, Small Hydropower Technology Center, Gamal Abdel Nasser University of Conakry (UGANC), Conakry, BP 1147, Guinea

Summary: This study examines the impact of salinity and brackish water conductivity on the chemical characteristics of Guinean mangrove soils and their suitability for making mud bricks. The waters of seven coastal and estuarine sites were analyzed to determine their chemical parameters (pH, CE, TDS, salinity) and compared to the characteristics of the adjacent soils. The results reveal a high variability between the parameters analysed at the water level (EC: 528 to 8,936 µS/cm; salinity: 10 to 300 mg/L) and at the soil level (acidic pH: 5.5–5.8; chlorides up to 265 mg/kg). This confirms the influence of saline intrusions on soil mineralization. Statistical analyses, based on robust methods (permutation and bootstrap tests), show a very strong correlation between CE and TDS ($r = 1.00$; $p < 0.001$) and highlight the major role of mineralization in the structuring of the data (PC1 ≈ 82%). These results highlight that areas with high mineralization (Kaporo Bridge, Tobolon) have high risks of efflorescence and brick degradation, while sites with low CE/TDS (Lambagni, Limbita 2) are more favorable. To ensure the durability of the bricks, corrective measures are recommended: pH adjustment by alkaline amendment, reduction of soluble salts by washing or partial substitution, and stabilization with appropriate binders. The integration of these practices is essential to limit the effects of saline intrusion and ensure the performance of earthen constructions in coastal areas.

Keywords: Salinity, electrical conductivity, soil, brackish water, bricks.

1. Introduction

Mangrove areas are located at the land-sea interface and are subject to saline intrusions and wetting-drying cycles that modulate soil chemistry (pH, salinity, conductivity, dissolved salt content) [1]. The salinity of the water and the specific conductivity, related to the ionic concentration (Na^+, Ca^{2+}, Mg^{2+}, K^+, Cl^-, SO_4^{2-}, HCO_3^-), affect the mobility of salts towards sediments and by capillary action, towards earthen building materials [2]. Soil salinity thresholds are commonly interpreted from saturated pulp extract (ECe), and salinity classes (non-saline, slightly, moderately, strongly, very strongly saline) are extensively documented [3]. In addition, the relationship between cation exchange capacity (CE) and total dissolved solids (TDS) of water is used to rapidly estimate mineralization (with the conversion factor dependent on ionic composition and temperature) [4, 5]. In earthy materials and masonry, salts promote efflorescence and saline crystallization (efflorescence/crypto florescence), which can induce

Corresponding author: Labilé Kolié, Ph.D., assistant research professor, research field: construction materials.

micro-cracks, splintering and loss of strength [6, 7]. Technical standards and guides (ASTM C1400, BIA TN 23A) provide efflorescence reduction measures (wall detailing, moisture management, material selection). Recent studies on bricks show degradation under the action of NaCl and $MgSO_4$, while civil engineering work has modelled the mechanical degradation of masonry subjected to the salt-dry-moisture cycles [8, 9]. At the mangrove level, recent syntheses and work describe the links between pH, salinity, nutrients and sedimentary properties, as well as the impacts of anthropogenic degradation on EC, TDS and nutrient availability [10, 11].

The conceptual framework of this study is based on the interaction between brackish water quality and soil chemistry, articulated around three main mechanisms: ion migration, which corresponds to the transfer of dissolved salts from the waters to the surface horizons of the soil; the accumulation of saline, marked by the progressive concentration of chlorides and sulphates in the clay matrix; and finally, the impact on the durability of bricks, linked to the alteration of mechanical properties by efflorescence and chemical reactions. Based on this framework, three research hypotheses (H) are formulated: (H1) high conductivity (> 5000 µS/cm) and high salinity (> 150 mg/L) of brackish water increase the soluble salt content of mangrove soils; (H2) soils exposed to these waters have a more acidic pH and high concentrations of chlorides and sulphates, reducing their suitability for making sustainable bricks; (H3) zones with low mineralization (EC < 3,000 µS/cm) offer more favorable conditions for brick production, subject to pH adjustment. This theoretical framework clarifies soil–water interactions and orients the analysis towards the evaluation of the durability of earthy materials in a saline context.

In this context, our objective is to relate the EC/TDS/salinity variability of local brackish water to the chemical properties of mangrove soils and to deduce the suitability of the land for brick making, articulating the analysis on methodological and recognized sustainability references.

2. Materials and Methods

2.1 Study Area

The study area concerns coastal and estuarine environments in Guinea, characterized by brackish waters subject to tidal dynamics and anthropogenic pressures. Seven sites were selected in this study, including Face Palais, Dixinn, Pont de Kaporo, Lambagni, Kobaya, Tobolon (Dubréka) and Terset (Dubréka). The choice of these sites is based on the fact that these sites represent a gradient of salinity and mineralization that may influence the adjacent mangrove soils used for the manufacture of mud bricks. Find below the hydromorphological location maps of the study area (Fig. 1).

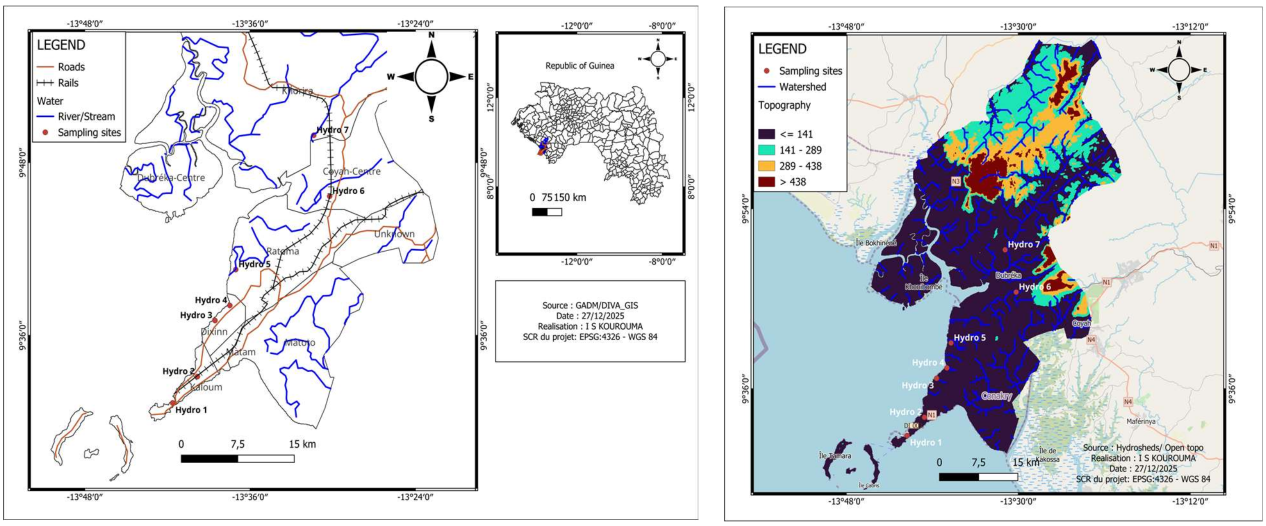

Fig. 1 Location and hydromorphological maps of the study area.

Table 1 Identification of surface water samples (IREG Code 20250150 01 to 07).

Identification of the ech.	Nature of the sample	Place of Direct Debit	Date Direct Debit	Date of Reception	Date Analysis
Hydro 1	Brackish water	Palace Face	05/11/2025	07/11/2025	From 07 to 10/11/2025
Hydro 2	Brackish water	Dixinn	05/11/2025	07/11/2025	From 07 to 10/11/2025
Hydro 3	Brackish water	Kaporo Bridge	05/11/2025	07/11/2025	From 07 to 10/11/2025
Hydro 4	Brackish water	Lambagni	05/11/2025	07/11/2025	From 07 to 10/11/2025
Hydro 5	Brackish water	Kobaya	05/11/2025	07/11/2025	From 07 to 10/11/2025
Hydro 6	Brackish water	Tobolon (Dubreka)	05/11/2025	07/11/2025	From 07 to 10/11/2025
Hydro 7	Brackish water	Terset (Dubreka)	06/11/2025	07/11/2025	From 07 to 10/11/2025

Table 2 Parameters analyzed and methods used.

Parameter	Method	Instrument
pH	Electrochemical	Portable pH meter (70+)
Temperature	Direct measurement	Portable probe
Conductivity / TDS	Electrochemical	Conductivity Meter (70+)
Salinity	Electrochemical	Conductivity Meter (70+)
Nutrients	Spectrophotometry	HACH DR 1,900 / DR 850
Heavy metals	Spectrophotometry	HACH DR 1,900

2.2 Sampling Strategy and Sample Retention

A set of seven (7) brackish surface water samples were collected between November 5 and 6, 2025 in inlets. The samples were taken in clean polyethylene vials and immediately refrigerated at around 4 °C. The samples were sent to the laboratory and analyzed within a maximum of 72 hours to preserve their physicochemical integrity. Find below the list of sampling sites (Table 1).

2.3 Analytical Materials and Instrumentation

Chemical analyses were performed using standardized handheld and laboratory equipment, including a handheld electrochemical pH meter (70+ series), an electrochemical conductivity meter (70+ series), a DO 9,100 dissolved oxygen analyzer, a Lovibond turbidity meter, as well as HACH DR 1,900 and DR 850 visible spectrophotometers for nutrient and heavy metal analysis.

2.4 Parameters Analysed and Analytical Methods

For chemical analyses, the parameters analyzed include pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), salinity, dissolved oxygen, turbidity, suspended solids (TSS), nutrients (phosphates, nitrates, nitrites and ammonium) as well as heavy metals (Fe, Mn, Zn, Cu, Pb, Cr, Ni, Cd and As). In situ measurements are based on electrochemical methods, while laboratory analyses were carried out by spectrophotometry. The results were compared to the WHO (2021) guideline values. Find below the list of parameters analyzed (Table 2).

2.5 Data Processing and Analysis of Soil–water Interactions

The processing of the data was based on an integrated approach, the analysis of brackish water chemical parameters and the chemical characterization of mangrove soils and adjacent continental soils. The data on surface water, from the analyses carried out by CEREG, were used to assess the level of mineralization of the aquatic environment and the intensity of saline intrusion in estuarine and mangrove areas. The key parameters used for this analysis are electrical conductivity, salinity and total dissolved solids, which are considered relevant indicators of the overall ionic charge of the waters.

The electrical conductivity measured on the seven water points show a marked variability, ranging from 528 µS/cm in Lambagni to 8,936 µS/cm in Kaporo Pont, reflecting contrasting hydrogeochemical contexts. Similarly, salinity levels vary between 10 and 300 mg/L, revealing differentiated degrees of marine influence depending on the site. These results made it possible to classify the waters according to their degree of mineralization and to identify areas subject to moderate to strong saline intrusion, likely to promote ionic exchanges with the riparian soils.

The data from the reference study on the Kénendé soils, Limbita 1 and Limbita 2 were then used to establish a direct soil-water comparison [12]. The chemical parameters of the soils considered include pH, electrical conductivity, dissolved solids, and chloride and sulphate contents. The soils of Kénendé and Limbita 1 have conductivities of 392 µS/cm and 434 µS/cm respectively, associated with high chloride (up to 265 mg/kg DM in Kenende) and sulphate (160 mg/kg DM) contents, while the soil of Limbita 2 is distinguished by a lower conductivity (150 µS/cm) and reduced concentrations of dissolved salts compared to its position at the sea.

The cross-analysis of soil–water data is based on the hypothesis that brackish water with a high mineralization constitutes a potential source of saline inputs to the soil, in particular through infiltration, capillary rise and ion exchange favored by tidal dynamics. These mechanisms can lead to a progressive accumulation of soluble salts in the surface horizons of soils, modifying their chemical balance and accentuating their acidic or saline character.

The interpretation of the results highlights a coherence between the high levels of water mineralization observed at certain sites (Kaporo Pont, Tobolon) and the high chloride and sulphate contents measured in the soils located near the mangrove areas, particularly in Kénendé. Conversely, areas characterized by less mineralized waters are associated with soils with a more stable chemistry, as observed at Limbita 2. This relationship suggests that the spatial variability of hydrological parameters directly influences the distribution and accumulation of salts in soils.

Finally, the data were interpreted from an applied perspective, in relation to the suitability of the soil for the manufacture of mud bricks. The analysis of soil–water interactions has made it possible to identify soils weakly influenced by saline intrusion as the most favourable for the production of sustainable bricks, while soils exposed to strong mineralization require corrective treatments aimed at limiting the impact of soluble salts on the durability of the materials. This integrated approach emphasizes the importance of considering soil–water interactions in the assessment and valuation of soil resources in coastal environments.

2.6 Statistical Analysis

In order to strengthen the robustness of the conclusions, statistical analyses were conducted: (i) Pearson correlations between EC, TDS, salinity and pH with p-values obtained by permutation tests (20,000 iterations); (ii) CE–TDS and CE–salinity linear regressions with bootstrap-estimated 95% confidence intervals (5,000 iterations); (iii) ANOVA, a permutation factor to test for differences between conductivity classes (Low < 2,000 µS/cm; Mid 2,000–4,999 µS/cm; High ≥ 5,000 µS/cm) on TDS and salinity; (iv) a principal component analysis (PCA) on pH, CE, TDS and salinity (standardised data).

To ensure the robustness of the analyses despite the small sample size (n = 7), non-parametric approaches were preferred. Permutation tests were used to estimate the p-values of correlations and intergroup comparisons, as they do not rely on the assumption of normality and are suitable for small datasets. Similarly, bootstrapping (5,000 iterations) allowed confidence intervals to be calculated for regression coefficients and correlations, generating empirical distributions by resampling. These methodological choices ensure better reliability of the estimates in a context where traditional methods would be unrobust $n = 7$.

3. Results

3.1 Brackish Water Analysis

Table 3 below presents the results of the analysis of the main brackish water chemical parameters measured at the different study sites, namely pH, electrical conductivity, total dissolved solids (TDS) and salinity. These parameters are essential indicators for the assessment of the level of water mineralization, the intensity of saline intrusion and the hydrochemical conditions likely to influence adjacent mangrove soils. It appears that the pH values are between 7.4 and 8.7. This indicates a generally neutral and slightly alkaline environment, characteristic of brackish waters subject to marine influence. On the other hand, electrical conductivity and TDS show a high spatial variability depending on the site, with moderate values at Lambagni (528 µS/cm; 264 mg/L) and very high values at Pont Kaporo (8,936 µS/cm; 4,468 mg/L) and Tobolon–Dubréka (8,410 µS/cm; 4,225 mg/L), reflecting contrasting degrees of mineralization. The salinity concentrations, varying from 10 to 300 mg/L, confirm this heterogeneity and highlight areas more highly exposed to saline intrusion.

3.2 Correlations between Electrical Conductivity and Total Dissolved Solids of Brackish Water Studied

Fig. 2 below illustrates the relationship between electrical conductivity (µS/cm) and total dissolved solids (TDS, mg/L) for the seven brackish water sites studied. This representation highlights a positive correlation between these 2 parameters. This shows that the higher the conductivity, the higher the concentration of dissolved solids, reflecting strong mineralization. The Kaporo Bridge (CE) sites ≈ 8,936 µS/cm; TDS ≈ 4,468 mg/L) and Tobolon–Dubreka (EC≈ 8,410 µS/cm; TDS ≈ 4,225 mg/L) are characterized by extreme values, indicating critical conditions for the migration of salts to mangrove soils. On the other hand, Lambagni (CE ≈ 528 µS/cm; TDS ≈ 264 mg/L) has low levels, suggesting a limited risk of saline accumulation. This correlation is essential to assess the impact of brackish water on soil chemistry and the durability of earthen bricks because strong mineralization promotes efflorescence phenomena and material degradation.

The CE–TDS relationship is highly significant ($r \approx 1.00$; $p < 0.001$), confirming that TDS is a good indicator of mineralization (Fig. 2). The EC–salinity correlation is positive but marginal ($p \approx 0.06$) (Fig. 3).

3.3 Correlations between Salinity and Electrical Conductivity of Brackish Water Studied

Figs. 4 and 5 show the correlation between salinity (mg/L) and electrical conductivity (µS/cm) of the seven brackish water sites studied. This representation highlights a general trend that explains why sites with high conductivity also higher salinity levels have, reflecting strong mineralization.

Table 3 Main brackish water chemistry measured at seven coastal and estuarine sites.

Site	pH	Conductivity (µS/cm)	TDS (mg/L)	Salinity (mg/L)
Palace Face	8.5	1,901	950	145
Dixinn	8.6	1,886	943	40
Kaporo Bridge	7.4	8,936	4,468	300
Lambagni	8.7	528	264	30
Kobaya	8.2	3,770	1,885	10
Tobolon–Dubreka	8.3	8,410	4,225	146
Terset–Dubreka	7.8	2,760	1,380	121

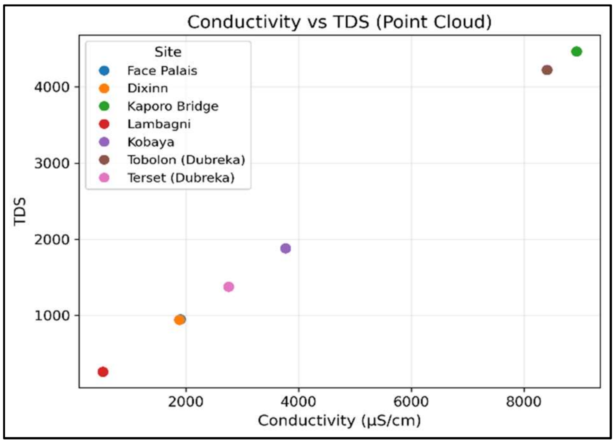

Fig. 2 CE vs TDS Point Cloud (7 sites).

CE vs TDS: $y = 0.501\ x + -2.6$; $R^2 = 1{,}000$ Confidence intervals obtained by bootstrap (5000 iterations).

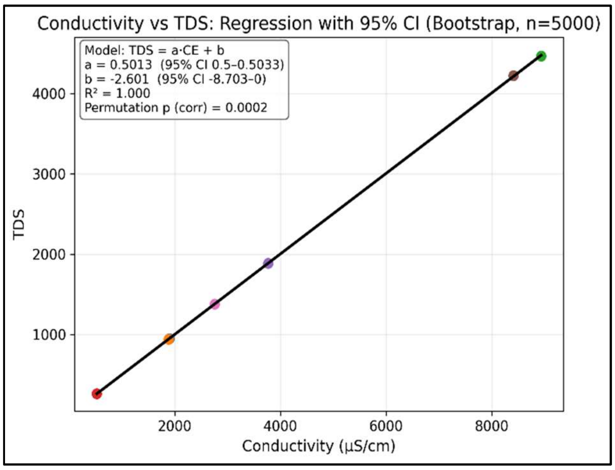

Fig. 3 CE vs TDS regression with 95% CI (bootstrap)

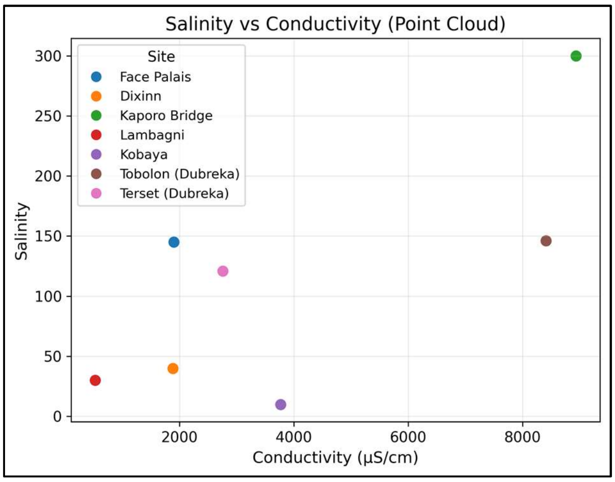

Fig. 4 Salinity vs Conductivity Point Cloud.

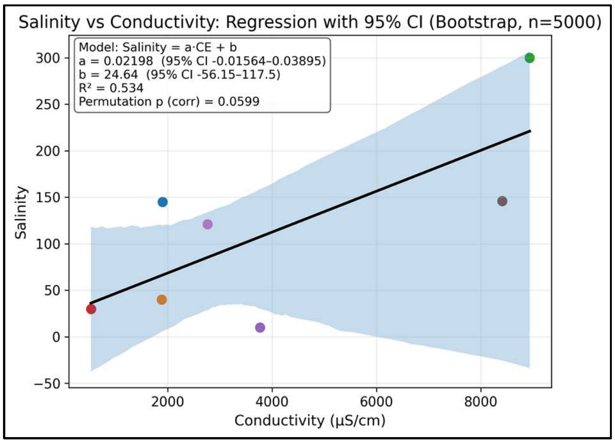

Fig. 5 Salinity regression vs CE with 95% CI (bootstrap).

Two sites stand out in particular:

- Pont Kaporo (EC ≈ 8,936 µS/cm; salinity ≈ 300 mg/L) and Tobolon–Dubreka (EC ≈ 8,410 µS/cm; salinity ≈ 146 mg/L) indicate critical conditions for salt migration to mangrove soils.
- Conversely, Lambagni (EC ≈ 528 µS/cm; salinity ≈ 30 mg/L) and Kobaya (EC ≈ 3,770 µS/cm; salinity ≈ 10 mg/L) have lower values, suggesting a limited risk of saline accumulation.

This relationship is essential to assess the potential impact of brackish water on soil chemistry and the durability of earthen bricks, as strong mineralization promotes efflorescence phenomena and material degradation.

The results below complete the analysis with correlations (r, p-value per permutation), linear regressions with Bootstrap confidence intervals, ANOVA by permutation on conductivity groups and PCA (pH, CE, TDS, Sal).

Table 4 Correlations (Pearson – p-value per permutation).

Variables	r (Pearson)	p (permutation)
CE–TDS	1.0	0.0003
EC–Sal	0.7308	0.0587
TDS–Sal	0.7295	0.0602
pH–CE	-0.6683	0.0898
pH–TDS	-0.6661	0.0906
pH–Sal	-0.7518	0.0488

3.4 Comparative Analysis of Brackish Water Chemistry

The radar pattern shown in Fig. 6 illustrates the normalized distribution (min–max) of the key chemical parameters measured at the seven brackish water sites studied: pH, electrical conductivity (EC), total dissolved solids (TDS), and salinity. Each axis corresponds to a parameter, and the values have been reduced to a common scale (0 to 1) in order to facilitate visual comparison between sites.

This graph highlights marked contrasts:

• Kaporo Bridge and Tobolon–Dubreka are distinguished by very high CE and TDS values, reflecting strong mineralization and an increased risk of saline intrusion into adjacent soils.

• Lambagni and Kobaya, on the other hand, have lower levels for these parameters, indicating less restrictive conditions for the manufacture of mud bricks.

• The pH remains high overall (close to neutral or slightly alkaline), while the salinity varies greatly, reaching maximum values at Pont Kaporo and Tobolon–Dubreka.

This synthetic representation makes it possible to quickly identify sites with high saline pressure, which can influence the chemistry of mangrove soils and, consequently, the durability of earthy materials.

The PCA (Fig. 7) shows that PC1 (81.99%) is dominated by mineralization (CE, TDS, salinity), while PC2 (12.02%) reflects the variation in pH. The Kaporo Bridge and Tobolon sites are distinguished by strong mineralization.

3.5 Comparison of Chemical Parameters Between soil and Brackish Water

Table 4 presents a comparative summary of the main parameters measured in mangrove and lateritic soils (Kénendé, Limbita 1 and Limbita 2) and in brackish water from seven sites. This comparison highlights significant contrasts:

For pH: Soils have acidic values (5.5–5.8), lower than water values (7.4–8.7), which can influence the reactivity of binders and the stability of earthen bricks.

For Electrical Conductivity and TDS: Soils have low conductivities (150–434 µS/cm) and limited TDS (75–217 mg/L), while waters show much higher levels (EC up to 8,936 µS/cm; TDS up to 4,468 mg/L), reflecting strong mineralization.

For salinity: Not measured in soils, it reaches up to 300 mg/L in water, which increases the risk of saline intrusion and efflorescence in earthy materials.

For Chloride and sulphate: The soils, that of Kénendé, have high levels (Cl^- = 265 mg/kg; SO_4^{2-} = 160 mg/kg), which may interact with dissolved salts in brackish water.

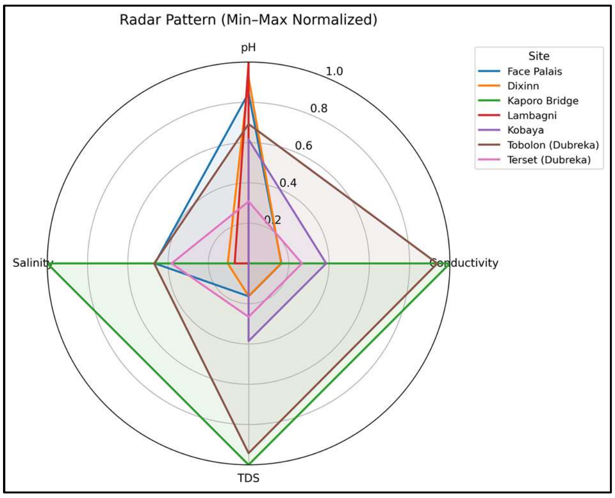

Fig. 6 Radar Pattern (pH, CE, TDS, Salinity) – min–max normalization.

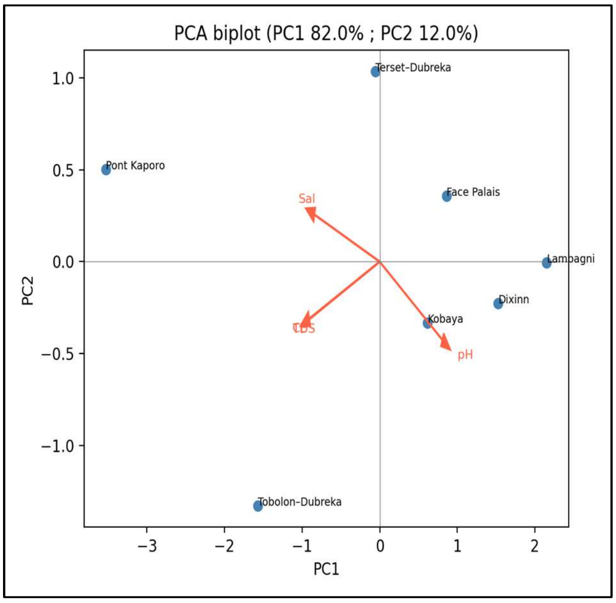

Fig. 7 Biplot PCA (scores & loads)

Table 4 Comparison of chemical parameters between soils and brackish water.

Parameter	Kénendé Soil	Limbita Floor 1	Floor Limbita 2	Water (min)	Waters (median)	Waters (max)
pH	5.5	5.8	5.7	7.4	8.3	8.7
Conductivity (μS/cm)	392	434	150	528	2760	8936
TDS (mg/L)	196	217	75	264	1380	4468
Salinity (mg/L)	—	—	—	10	121	300
Chlorides (mg/kg)	265	116	132	(unmeasured)	(unmeasured)	(unmeasured)
Sulphates (mg/kg)	160	8	16	(unmeasured)	(unmeasured)	(unmeasured)

This analysis highlights the importance of controlling the salinity and conductivity of the surrounding water to limit the migration of salts to the soil and prevent the degradation of earthen bricks. It also highlights the need for corrective pH treatment and proper stabilization to ensure the durability of the materials.

4. Discussion

The Kaporo Bridge and Tobolon–Dubreka sites are distinguished by very high CEs (≥ 8,000 μS/cm) and high TDS, indicating strong mineralization that may increase ionic fluxes to the mangrove soils and brick matrix. The literature shows that the CE–TDS relationship is useful for rapidly estimating ion charge but is highly dependent on ionic composition (monovalent vs. divalent) and temperature, which justifies a local and cautious calibration [4, 13, 14]. The FAO and USDA guides recall the use of ECe to classify soil salinity and guide agronomic and material management decisions [15, 16]. In masonry and earthy materials, efflorescence and saline crystallization ($NaCl$, $MgSO_4$ in particular) cause surface deposits and, in confined pores, crystallization pressures that can induce cracking and splintering. Indeed, tests on grey bricks confirm marked damage under $MgSO_4$ and $NaCl$ while $CaCl_2$ is less aggressive, and mechanical models under salt-drying cycles account for the degradation of resistance [17, 18]. ASTM C1400 and BIA TN 23A recommend the control of water intake, wall detailing, and the selection of materials with a low soluble salt content to reduce efflorescence [19]. Finally, in soils stabilized with lime/cement, the presence of sulphates can lead to expansive reactions (ettringite) and dysfunctions, particularly in clay matrices. However, PCA reviews and classic works (TRB/HRB) insist on vigilance in the sulphate context and on the need to adapt the choice of binders (low C3A) or procedures [20-21].

The results obtained confirm that electrical conductivity (EC) and total dissolved solids (TDS) are strongly correlated ($r \approx 1.00$; $p < 0.001$), which validates the use of TDS as a reliable indicator of brackish water mineralization. This observation is consistent with the work of Yue et al. [23], which have shown that the presence of dissolved salts, in particular $NaCl$ and $MgSO_4$, promotes saline crystallization in porous materials, thus leading to internal pressures responsible for cracking and efflorescence. Similarly, Li et al. [17] have shown that ionic migration and crystallization in the pores of bricks significantly reduce their mechanical strength, especially under the effect of wet-dry cycles.

The correlation between EC and salinity, although positive ($r \approx 0.73$), has a marginal p-value ($p \approx 0.06$). This statistical limitation can be explained by the small sample size ($n = 7$) and the ionic variability of brackish water (presence of chlorides, sulphates and other ions in varying proportions). An increase in the number of sites and a seasonal analysis would confirm or refute this trend. The PCA performed shows that PC1 (≈ 82%) is dominated by mineralization (EC, TDS, salinity), while PC2 (≈ 12%) reflects the variation in pH, which corroborates the major influence of dissolved salts on soil chemistry.

Mechanistically, the ionic migration of brackish water to soils, followed by saline accumulation in the clay matrix, promotes the formation of surface blooms and internal crystallizations (crypto florescences). These phenomena induce crystallization pressures that can cause micro-cracks, brick splintering and a gradual loss of strength. The studies by Yue et al. [23] and Li et al. [17] confirm that these mechanisms are amplified by the wetting-drying cycles, which are frequent in coastal areas, which underlines the need for corrective treatments (pH adjustment, salt reduction, stabilization).

5. Recommendations for Making Mud Bricks

The following recommendations are based on analytical results and scientific references, to reduce the impact of salinity and conductivity on soil quality and to optimize the manufacture of mud bricks in coastal areas.

The selection of sampling sites is a crucial step in limiting the risks associated with salinity. Water with a conductivity of less than 3,000 µS/cm and a salinity of less than 150 mg/L are considered less aggressive to soils and earthy materials. Studies have shown that high conductivities (> 5,000 µS/cm) promote the migration of salts and their crystallization in the pores of the bricks, leading to efflorescence and cracking [23]. Thus, avoiding heavily mineralized channels is essential to ensure the durability of the bricks [24].

The pH of the soil is another determining factor. The soils studied have acidic values (5.5–5.8), below the recommended range (6.5–8.0) for good binder reactivity. A pH that is too low reduces the cohesion and mechanical strength of the bricks. The addition of aerial or hydraulic lime (1–3%) is a common practice to correct this acidity and improve plasticity, as confirmed by [25], which observed a significant improvement in mechanical properties after alkaline amendment.

The reduction of salt in soil is also essential. Chlorides and sulphates present in high concentrations can cause undesirable chemical reactions and efflorescence. The References [26] and [27] recommend washing the fines with fresh water or the partial substitution (≤ 20%) of the saltiest fractions to limit these effects. These measures reduce the soluble salt content before the bricks are manufactured.

For stabilization, the addition of 5–8% binder (lime or cement) is recommended to improve strength and durability. In the presence of sulphates, it is preferable to use cements with a low C_3A content or lime, in order to avoid swelling linked to sulphate reactions [28]. A controlled wet cure is also necessary to ensure a good grip and limit saline suction.

Finally, quality control on the construction site is essential. It shall include measurement of the pH, conductivity and TDS of the mixing slurry, as well as compression and water absorption tests. [29] insist on the importance of these controls to prevent defects related to salinity and guarantee the performance of the bricks. The monitoring of efflorescence after drying completes this monitoring system.

6. Conclusion

The present study highlights the decisive influence of the salinity and conductivity of brackish water on the chemistry of mangrove soils and their suitability for the manufacture of mud bricks. The results show that sites with high mineralization, such as Pont Kaporo and Tobolon–Dubréka, present a high risk of saline accumulation in soils, promoting efflorescence phenomena and material degradation. In contrast, areas with low EC/TDS, such as Lambagni and Limbita 2, offer more favourable conditions, subject to pH adjustment and reduction of soluble salts.

The statistical analysis, supported by robust methods (permutation and bootstrap tests), confirms the close correlation between CE and TDS ($r = 1.00$; $p < 0.001$) and highlights the major role of mineralization in the structuring of the data (PC1 ≈ 82%). These results highlight the need to integrate the monitoring of hydrogeochemical parameters into the management of soil resources and the production of materials in coastal areas ($r \approx 1,\ p < 0.001$).

To guarantee the durability of the bricks, corrective measures are essential: alkaline amendment to correct the acidity of the soil, reduction of soluble salts by washing or partial substitution, and stabilisation with suitable binders. These recommendations are essential levers to limit the effects of saline intrusion and ensure the performance of earthen constructions in environments subject to hydrogeochemical stresses.

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