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Assessing the Effects and Strategies of Soil Erosion Management on Biu Plateau, Borno State Northeast Nigeria

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Abstract
Soil erosion is a major driver of land degradation on the Biu Plateau, Borno State, Nigeria, where fragile soils, dissected topography, erratic rainfall and expanding human activity have accelerated the loss of productive land. This study evaluated the effects and management strategies of soil erosion. Purposive and simple random sampling techniques was applied to administer the copies of structured questionnaire to 400 respondents across fifteen settlements. The result revealed that erosion effects rose from a mean of 1.24 in Very Low to 2.76 in Very High settlements, corroborated by organic matter declining 75 per cent, pH falling 2.57 units and bulk density rising 18 per cent across the same gradient. Result further indicates that conservation adoption fell from 1.69 to 1.08 strategies over that gradient, a reduction of 36 per cent, and was unrelated to awareness or education, indicating a material rather than informational constraint. The study concludes that conservation effort is inversely distributed relative to need and constrained materially rather than informationally, and that susceptibility will worsen despite a greening landscape, so that land cover state is not by itself a reliable indicator of the direction of degradation. It recommends spatial rather than demand-led targeting, material support in place of sensitization in the worst-affected settlements, soil amendment before vegetative measures, public financing given the downstream costs of sedimentation, and conservation planning extended to areas of emerging as well as existing risk.

Keyword: Soil, Erosion, Effect, Strategies, Management, Plateau

Introduction

Soil erosion has emerged as a critical environmental challenge worldwide, with particularly severe consequences in regions like the Biu Plateau in northeastern Nigeria. This area, characterized by fragile soils, steep topography, and increasing human activity, faces accelerated rates of erosion. The loss of fertile topsoil has a cascading effect on agricultural productivity, directly impacting food security and the livelihoods of communities dependent on farming (Lal, 2019). Despite its significance, there is insufficient localized research to address soil erosion's specific causes and effects on the Biu Plateau. However, human activities, such as deforestation

and unsustainable agricultural practices, exacerbate the natural vulnerabilities of the Biu Plateau. Large-scale clearing of vegetation for farming and grazing has left soils exposed, leading to higher rates of surface runoff and erosion. The lack of awareness and implementation of effective soil conservation strategies further aggravates this problem, leaving vast areas of the plateau unproductive and degraded (Panagos *et al*., 2015).

The socio-economic implications of soil erosion are profound, affecting agricultural productivity, infrastructure, and livelihoods. On the Biu Plateau, erosion-induced land degradation reduces the availability of arable land, forcing farmers to migrate or abandon traditional farming practices. Eze *et al*. (2019) noted that addressing soil erosion is critical for achieving sustainable development goals, particularly those related to poverty alleviation and food security. Efforts to mitigate soil erosion must involve both scientific research and community engagement. Baba *et al*. (2022) stressed the importance of participatory approaches in promoting soil conservation practices. Engaging local farmers in planning and implementation not only ensures the adoption of sustainable practices but also fosters a sense of ownership and accountability. Policy support is equally vital in addressing the challenges of soil erosion. Effective land-use regulations and incentives for adopting conservation practices can significantly reduce erosion risks. Okonkwo *et al*. (2018) advocated for government-led initiatives, such as afforestation programs and erosion control structures, to complement community efforts.

Materials and Method

Study Area

The Biu Plateau is situated in the southern part of Borno State, Nigeria, extending into parts of the northeastern geopolitical zone of the country. It is a prominent volcanic plateau characterized by its elevated terrain, rugged landscapes, and unique geological and ecological features. The plateau lies approximately between latitudes 10°30′N and 11°30′N and longitudes 11°30′E and 12°30′E, covering an extensive area of about 5,200 square kilometers (Figure 1).

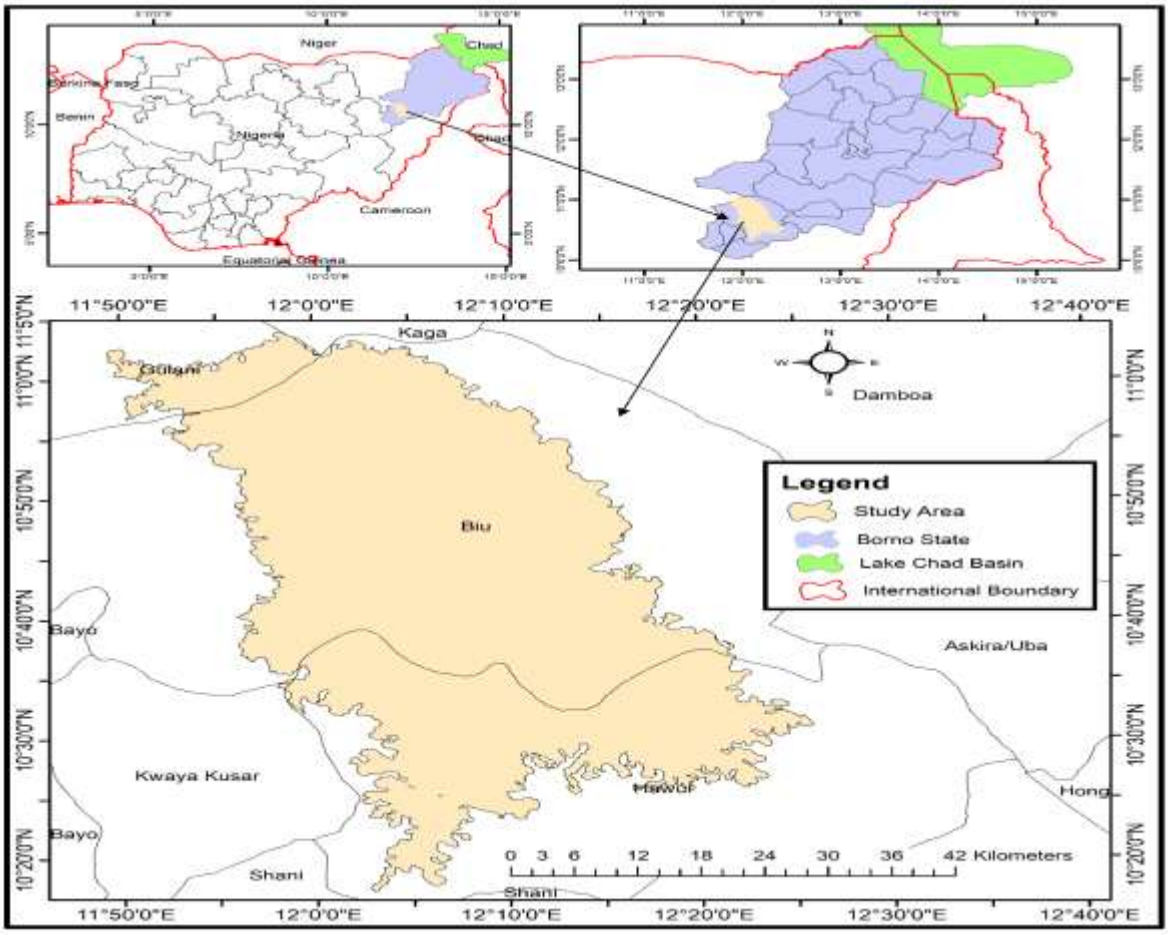


Figure 1: Study Area
Source: GIS Laboratory Analysis, 2026

The Biu Plateau in Borno State, Nigeria, is a prominent highland feature, with elevations ranging between 800 and 1,500 meters above sea level. It is a volcanic plateau characterized by rugged terrain, hills, and valleys formed by ancient lava flows. The relief significantly influences the region's microclimate and agricultural potential, with elevated areas experiencing cooler temperatures conducive to certain crops. The plateau's topography is marked by steep slopes that contribute to rapid surface runoff, increasing susceptibility to soil erosion and sedimentation in lower-lying areas (Ali *et al.*, 2021).

The drainage system of the Biu Plateau is defined by numerous seasonal streams and rivers, which originate from the highlands and flow towards the surrounding lowlands. Major rivers such as the Hawul and Gongola are crucial for water supply and agricultural activities in the region. These rivers are characterized by high variability in flow, with peaks during the rainy season and reduced flow in the dry season. This variability often impacts water availability for irrigation and domestic use, posing challenges for local communities (Audu *et al*., 2019).

The soils of the Biu Plateau, located in Borno State, Nigeria, are largely influenced by the region's volcanic origin, topography, and semi-arid climate. Derived from basaltic parent materials, the soils are typically sandy to loamy in texture and are rich in iron and aluminum oxides, giving them a reddish appearance (Ali *et al*., 2021). These properties make the soils moderately fertile, supporting crops like millet, sorghum, and groundnuts, which are staple crops in the region (Ogundele *et al*., 2019). However, the inherent fertility is often limited by nutrient leaching, particularly during the rainy season. Erosion is a significant concern for the soils of the Biu Plateau due to the steep slopes and heavy seasonal rainfall. This results in the loss of topsoil, reducing agricultural productivity and affecting water quality downstream.

Methods

400 copies of structured questionnaire described the human dimension of the erosion including respondent socio-economic characteristics, awareness of soil erosion, perceived causes, observed effects, and the erosion management strategies practiced by respondents' households.

Stratification and Selection

A stratified design was therefore adopted, with erosion susceptibility class as the stratification variable running from very low, low, moderate, high and very high, formed the strata. Within each stratum three settlements were selected purposively, on the basis that each fell wholly within the class concerned and was accessible for fieldwork, giving fifteen settlements in total.

Equal allocation was applied, with 80 respondents drawn from each susceptibility class and 26 or 27 from each settlement. Respondents were selected within settlements by simple random sampling from households present at the time of the survey. Equal rather than proportional allocation was adopted because the purpose of the survey was to compare erosion effects and management practice between susceptibility classes rather than to estimate their prevalence across the plateau as a whole. Equal allocation maximizes the statistical power of between-stratum comparison and ensures that the very high class, which occupies a comparatively small proportion of the plateau, is as fully represented as the more extensive classes. Because each settlement falls wholly within one susceptibility class, respondents are clustered within settlements.

Effects of Soil Erosion

The descriptive statistics frequencies and percentages were used to summarized the qualitative data for each reported effect by susceptibility class. Cochran's Q test was applied to establish whether the five effects were reported at equal rates across the sample, since the items form a multiple-response set and cannot be assumed equally prevalent.

The Pearson chi-square test was computed as a secondary check and Cramér's V reported as a measure of association strength. The Benjamini–Hochberg procedure was applied to control the false discovery rate across the five effect variables.

Results and Discussions

Overall Pattern of Erosion Impact Across the Susceptibility Gradient

Table 1 presents the proportion of residents reporting each of the five erosion effects, disaggregated by the erosion susceptibility class of their settlement.

Table 1: Reported effects of soil erosion by erosion susceptibility class

Reported effect	Very Low %	Low %	Moderate %	High %	Very High %	Ratio VH:VL	p
Loss of fertile topsoil	30.0	30.0	36.2	53.8	56.2	1.88	<0.001
Sedimentation	20.0	40.0	42.5	52.5	50.0	2.50	<0.001
Increased surface run-off	26.2	27.5	46.2	47.5	53.8	2.05	<0.001
Infrastructure damage	20.0	32.5	36.2	42.5	56.2	2.81	<0.001
Habitat loss	27.5	28.7	33.8	55.0	60.0	2.18	<0.001

Source: Field survey, 2025.

The result revealed that infrastructure damage are 2.81 times more frequent in the Very High class than in the Very Low class, sedimentation 2.50 times, habitat loss 2.18 times, increased surface run-off 2.05 times and loss of fertile topsoil 1.88 times. The increase is progressive across the intervening classes rather than confined to the extremes, so the pattern describes a continuous gradient of impact rather than a threshold beyond which problems suddenly appear.

A clearer picture of what changes along this gradient emerges when the number of effects reported by each respondent is counted rather than each effect being examined separately. Table 2 presents this measure.

Table 2: Number of erosion effects reported per respondent, by susceptibility class

Susceptibility class	Mean number of effects	Standard deviation	Median
Very Low	1.24	0.97	1
Low	1.59	1.13	1
Moderate	1.95	1.16	2
High	2.51	1.10	3
Very High	2.76	1.21	3

Source: Field survey, 2025. Range 0–5 in every class; n = 80 per class.

Residents of the most susceptible settlements report on average 2.76 of the five effects, compared with 1.24 in the least susceptible settlements, an increase of 122 per cent that proceeds without interruption through all five classes. Statistically, each one-step rise in susceptibility class is associated with a 22.3 per cent increase in the expected number of effects reported (95% CI 17.7 to 27.1 per cent). This is the central finding of the section, and it carries a specific meaning: what distinguishes a highly susceptible settlement from a less susceptible one is not that a different kind of erosion problem occurs there, but that several problems occur together.

The result suggest a straightforward reason for this. When the counts for the five effects are compared against one another across the whole sample, they are statistically indistinguishable, ranging only from 150 to 165 respondents out of 400. No single effect dominates. What varies is how many of them a given community is experiencing at once. This is consistent with erosion operating as a connected sequence rather than as a set of independent hazards: detachment of the surface soil reduces infiltration, which increases run-off, which transports sediment downslope, which is deposited in channels and against structures, and which removes the vegetation and soil conditions on which habitat depends. Where the process is weak, only its earliest expressions are visible; where it is advanced, the whole chain becomes visible simultaneously. Majoro *et al*. (2020), reviewing the on-site and off-site consequences of erosion on agricultural land, describe precisely this cascade from detachment through transport to deposition, and note that the off-site consequences are systematically under-recognized because they appear away from the point of origin.

The practical implication is that susceptibility class has corresponds to a measurable difference in how much erosion damage residents actually encounter, and it therefore has direct value as a targeting instrument. A settlement placed in the High or Very High class is not merely at greater theoretical risk; its residents are already contending with roughly twice as many distinct erosion problems as residents of the Low and Very Low settlements. Intervention prioritized on the susceptibility map would reach the communities carrying the heaviest present burden, not only those facing the greatest future one.

Loss of Fertile Topsoil and Depletion of Soil Organic Matter

Result of topsoil loss rise from 30.0 per cent of residents in the Very Low class to 56.2 per cent in the Very High class (Table 3).

Table 3: Measured soil properties by erosion susceptibility class (settlement means)

Soil property	Very Low	Low	Moderate	High	Very High	Change
pH (water)	6.80	5.95	5.39	4.70	4.23	−2.57 units
Organic matter	2.13	2.35	1.50	1.05	0.54	−75%
Silt (%)	41.5	37.6	28.3	21.3	21.0	−49%
Clay (%)	20.5	17.7	25.0	34.7	38.7	+88%
Sand (%)	38.0	44.7	46.7	44.0	40.3	no trend
Bulk density (g/cm³)	1.10	1.01	1.11	1.18	1.30	+18%
Electrical conductivity (dS/m)	0.16	0.17	0.22	0.30	0.37	+131%
Total exchangeable acidity (cmol/kg)	10.09	10.95	12.89	14.03	13.76	+36%
Exchangeable Ca (cmol/kg)	1.52	1.23	2.12	2.73	2.86	+88%
Total nitrogen	0.13	0.13	0.16	0.18	0.24	+85%
Available P (mg/kg)	43.7	40.0	49.7	53.0	59.3	+36%

Source: Laboratory analysis, 2025. Change is calculated between the Very Low and Very High class means. All properties shown differ significantly across the gradient except sand content.

Organic matter falls by three-quarters across the gradient, from 2.13 in the least susceptible settlements to 0.54 in the most susceptible. This is the single largest proportional change recorded in the soil dataset, and it is a direct physical counterpart to what residents' report. Organic matter is concentrated in the uppermost few centimeters of the profile and is associated with the lightest and most easily transported soil fractions, so it is removed early and disproportionately when the surface is eroded. The magnitude of the loss is consistent with what has been measured directly under runoff conditions in comparable West African environments. Kabore *et al.* (2019), working on runoff plots in Ghana, found that fine soil particles were removed with enrichment ratios of 1.14 to 3.6, whereas coarse sand fractions were removed at ratios of only 0.62 to 0.88. Erosion, in other words, does not remove soil uniformly; it selectively strips the fine, organic-rich material that carries most of the soil's fertility and leaves the coarse mineral skeleton behind. Kanianska *et al.* (2024), examining an erosion transect under grassland and arable land, similarly recorded organic carbon declining in step with rising bulk density and falling with position along the erosion slope. The implication for agriculture on the

plateau is serious, and the international evidence allows it to be stated with some precision. Zhang *et al*. (2021), synthesizing 290 observations from topsoil removal experiments worldwide, established that crop yields do not decline significantly while the remaining A horizon exceeds 25 cm or erosion depth remains below 5 cm, but that once erosion depth exceeds 20 cm yields cannot be restored to pre-erosion levels even with conventional fertilization and irrigation. The organic matter and pH values recorded in the High and Very High settlements of the Biu Plateau are characteristic of surface horizons that have already been substantially removed rather than merely thinned. If that interpretation is correct, parts of the plateau are approaching or have passed the point at which fertilizer inputs can compensate for the loss, and conservation on those lands is a matter of arresting further loss rather than of restoring what has gone.

Soil Acidification and the Loss of Base Cations

The most consistent chemical change recorded across the gradient is a decline in soil reaction, from a near-neutral pH of 6.80 in the least susceptible settlements to 4.23 in the most susceptible, a fall of 2.57 pH units. Total exchangeable acidity rises correspondingly, from 10.09 to 13.76 cmol/kg. Soils at pH 4.23 are strongly acid, and at this reaction aluminium becomes soluble in quantities toxic to the roots of most cereal and legume crops grown on the plateau. Two processes evident account for this. The first is the removal of the base-enriched surface horizon itself. Bases held on exchange sites in the organic-rich topsoil are lost with the eroded material, leaving a surface dominated by more weathered and inherently more acid subsoil. The second is the loss of organic matter, which is itself a major source of pH buffering; as organic matter falls by three-quarters, the soil's capacity to resist acidification falls with it. The two operate together, which explains why the pH decline is so nearly uniform across the gradient while individual base cations behave less consistently.

It is important to record that the direction of pH change under erosion is not universal, and the Biu result should not be generalized without qualification. Boja *et al*. (2025), studying soils along an eroded road right of way in southern Ethiopia, found the opposite: pH was higher in eroded fields (8.48 to 8.66) than in non-eroded fields (8.18 to 8.30). Studies in the savanna of north-eastern Nigeria have reported the same upward direction, attributing elevated pH at eroded sites to the exposure of alkaline, mineral-rich subsoil. Tully *et al*. (2015), reviewing soil degradation across sub-Saharan Africa, reconcile these observations by noting that alkalization occurs where calcareous subsoil material is brought into the topsoil by erosion or tillage, whereas acidification occurs where the profile lacks such material and base loss dominates. The Biu Plateau soils, developed on basaltic and weathered basement material with a near-neutral rather than calcareous baseline, fall into the second case. The direction of pH change is therefore governed by parent material, and it is the magnitude and consistency of the change, not its sign, that indicates erosional modification.

The management implication is specific. Where erosion produces acidification of this severity, conservation measures alone will not restore productivity, because the chemical constraint persists after soil movement has been arrested. Amelioration on the High and Very High lands of the plateau would require liming or the use of acid-tolerant varieties alongside physical

conservation. Trials across sub-Saharan Africa have shown that acid-tolerant maize varieties raised yields by 51 per cent under low soil pH in Cameroon and Kenya, which indicates the scale of the recoverable loss and suggests a low-cost entry point for extension services on the plateau.

Increased Surface Run-off and the Self-Reinforcing Nature of Degradation

The result reported an increase in surface run-off, a rise from 26.2 per cent of residents in the Very Low class to 53.8 per cent in the Very High class. The soil data indicate why this occurs and why it matters more than the figures alone suggest. Run-off is generated when rainfall arrives faster than the soil can absorb it. Two of the measured changes reduce absorption capacity directly. The loss of three-quarters of the soil organic matter removes the principal agent binding soil particles into stable aggregates, so raindrop impact breaks the surface down more readily and forms a surface seal. The rise in bulk density reflects the loss of the pore space through which water would otherwise enter. Acidification compounds both effects: Zhu *et al*. (2025) demonstrated experimentally that the aggregate stability energy of water-stable microaggregates falls by an average of 14.04 J/g for every 0.1 unit decline in pH, with a 46.5 per cent overall reduction across the acidification range they simulated. Across the 2.57 pH unit decline recorded on the Biu Plateau, a substantial deterioration in aggregate stability would be expected on this evidence alone.

These conditions meet a rainfall regime well suited to exploiting them. Peak rainfall intensities of 120 to 160 mm per hour have been recorded in the savanna of northern Nigeria, intensities sufficient to break up soil aggregates, seal and compact the surface, and reduce infiltration, culminating in increased run-off and further soil loss. Chapter Four established rainfall erosivity on the plateau at 792.69 to 1108.64 MJ·mm/ha/hr/year, which is moderate to high by regional standards and is distributed within a short and intense wet season. The significance of this finding is that it identifies positive feedback rather than a static condition. Erosion removes organic matter; the loss of organic matter weakens aggregates and raises bulk density; weakened aggregates and higher bulk density reduce infiltration; reduced infiltration increases run-off; increased run-off accelerates erosion. Each cycle strengthens the conditions for the next. This has a direct bearing on the timing of intervention, because it means the cost of inaction is not constant but rising.

Sedimentation and Off-Site Consequences

Reports of sedimentation rise from 20.0 per cent in the Very Low class to 50.0 per cent in the Very High class. This effect behaves differently from the others in one respect that is worth noting: its association with susceptibility class, while clearly present, is the least stable of the five when other respondent characteristics are taken into account, and it does not increase further between the High and Very High classes. This is what the nature of the process would lead one to expect. Sedimentation is an off-site effect. Material detached in one place is deposited in another, generally downslope and often in a different settlement from the one where erosion occurred. Residents therefore report deposition where it accumulates, which need not be where susceptibility is highest. Majoro *et al*. (2020) make this distinction central to their review of erosion effects, observing that sediment transported in rivers goes on to affect bridges,

hydropower plants, water treatment plants and water supply infrastructure far from the eroding fields. The spatial decoupling of cause and effect is intrinsic to sedimentation and is not a weakness of the present measurement.

The off-site burden is substantial in the northern Nigerian context. Ezemonye and Emeribe (2024), modelling soil loss in the Gubi watershed of Bauchi State with RUSLE, recorded erosion rising from 14,244 tonnes per year in 2000 to 16,792 tonnes per year in 2017, with catchment sediment yield increasing from 6,904 to 9,173 tonnes per year and the sediment delivery ratio rising from 48.5 to 54.6 per cent. Sediment inflow to the Gubi reservoir approached 951 tonnes per year by 2017, and the authors concluded that these deposits have the potential to shorten the design life of the reservoir. Mama and Okafor (2011) report Nigerian cases in which siltation rendered water storage structures effectively useless within 25 years, with the problem concentrated in small and medium reservoirs serving catchments below 100 km².

Damage to Infrastructure

Infrastructure damage shows the steepest relative increase of all five effects, rising from 20.0 per cent of residents in the Very Low class to 56.2 per cent in the Very High class, a ratio of 2.81. It is also the effect reported least often overall, by 150 of 400 respondents, which indicates that it is concentrated in the more susceptible settlements rather than diffused across the plateau. The pattern is consistent with the threshold behaviour of erosion damage to structures. Sheet erosion removes soil progressively and its effects on buildings and roads accumulate slowly, but once concentrated flow establishes rills and then gullies, the damage becomes rapid and visible. Structures are undermined, road surfaces are cut, culverts and drainage works are outflanked, and the effect is unmistakable to residents. Settlements in the lower susceptibility classes are largely below this threshold, while those in the upper classes have crossed it.

Findings from comparable Nigerian settings support this reading. Yakubu *et al*. (2025), assessing gully control in the Gombe metropolis, found that engineering interventions dominate the response and are notably costly, which indicates the expense that follows once damage has reached this stage. The wider financial context makes the case for early action. Analyses of Nigerian flood and erosion damage for 2024 and 2025 place combined direct and indirect national costs above ₦13 trillion, of which housing and property accounted for approximately ₦6.2 trillion and agriculture ₦4.1 trillion. Against expenditure of this order, the cost of vegetative and structural conservation on the eight settlements identified in this study as High or Very High susceptibility is modest. The implication for policy on the plateau is that infrastructure damage should be treated as a lagging indicator: by the time it is widely reported, the cheaper agronomic remedies have already been overtaken by the need for engineering works.

Habitat Loss

Habitat loss shows the strongest and steepest association with susceptibility class of the five effects examined, rising from 27.5 per cent of residents in the Very Low class to 60.0 per cent in the Very High class, and it is the only effect reported by a clear majority of residents in the most susceptible settlements. The soil data indicate why the relationship should be this strong.

Vegetation on the plateau depends on the surface horizon for rooting, nutrient supply and water retention, and every measured property governing those functions deteriorates along the gradient: organic matter falls by three-quarters, pH falls into the range at which aluminium toxicity restricts root growth, bulk density rises, and infiltration is reduced. Vegetation loss and soil loss are therefore mutually reinforcing rather than sequential. Reduced plant cover exposes the soil to raindrop impact and accelerates erosion, while the resulting degradation of the rooting zone makes recovery of plant cover progressively more difficult. Shokri *et al.* (2025), in a recent global review of soil degradation, describe this as a self-perpetuating relationship in which biodiversity declines through habitat loss and ecosystem resilience falls with it, leaving degraded land more susceptible to floods, droughts and climate extremes.

The consequence is particularly significant in a dryland setting such as the Biu Plateau, where vegetation cover is the principal buffer against further degradation and where the boundary between degraded land and desertified land is narrow. Roughly a quarter to a third of the world's drylands are already degraded, and the loss of dryland biodiversity is recognized as both a cause and a consequence of that degradation. On the plateau, the finding indicates that erosion is not only removing soil but also eroding the ecological capacity of the land to recover from soil loss.

Management Strategies for Soil Erosion on the Biu Plateau

Extent and Composition of Conservation Practice

Table 4 presents the proportion of residents reporting each conservation practice, disaggregated by the erosion susceptibility class of their settlement.

Table 4: Adoption of erosion management strategies by susceptibility class

Management strategy	All %	Very Low %	Low %	Moderate %	High %	Very High %	Trend
Afforestation and reforestation	35.8	42.5	46.2	38.8	28.7	22.5	Declining
Cover cropping	37.5	42.5	50.0	38.8	33.8	22.5	Declining
Contour bunding and ploughing	37.2	47.5	43.8	30.0	31.2	33.8	Declining
Terracing	35.8	36.2	38.8	37.5	37.5	28.7	no trend

Source: Field survey, 2025. Percentages describe adoption within each susceptibility class

The four strategies are practiced at broadly similar overall rates, between 35.8 and 37.5 per cent of residents. Some form of conservation is therefore not unusual on the plateau: 82.3 per cent of respondents reported using at least one of the four measures, and only 17.8 per cent reported using none. This is a higher participation rate than has been recorded in several comparable settings. Ngetich *et al.* (2024), surveying smallholders in the central highlands of Kenya, found that 65.3 per cent had adopted soil and water conservation practices, while Corbeels *et al.* (2024)

report that conservation agriculture is practiced on only about 1.25 per cent of the total cultivated area of sub-Saharan Africa despite two decades of promotion.

The composition of practice revealed that residents adopt on average only 1.46 of the four measures, and just 15.5 per cent adopt three or more. Partial rather than complete adoption is the norm, which is consistent with the wider evidence that smallholders in resource-constrained environments adopt single practices or pairs of practices rather than full conservation packages. The finding matters for how conservation performance on the plateau should be judged. Measured by whether households do anything at all, the plateau performs well. This has an immediate implication for programme design. Interventions evaluated against a target of participation, such as the number of households reached or sensitized, would record success on the Biu Plateau. Interventions evaluated against the depth of protection achieved would record something closer to failure. Since erosion control depends on the combined effect of vegetative cover, surface roughness and slope interruption acting together, indicators based on participation alone will systematically overstate the protection actually in place.

Conservation Effort and Measured Soil Condition

Table 5 presents the settlement-level relationship between mean conservation adoption and measured soil condition. The result indicates an inverse distribution of conservation effort against the laboratory data independently of the survey.

Table 5: Settlement-level correlation between conservation adoption and soil condition

Settlement characteristic	Correlation with mean strategies adopted	P
Organic matter	+0.80	<0.001
Soil Ph	+0.76	0.001
Silt content	+0.68	0.006
Electrical conductivity	−0.77	<0.001
Clay content	−0.69	0.005
Bulk density	−0.68	0.005
Erosion effects reported by residents	−0.72	0.003

Source: Field survey and laboratory analysis, 2025.

The result revealed that settlements with higher organic matter, higher pH and higher silt content practice more conservation; settlements with denser, more clay-rich, more conductive soils practice less. Conservation adoption correlates negatively with the number of erosion effects residents report. The two extremes make the point plainly. Durkwa records the highest conservation adoption on the plateau at 2.00 strategies per resident, alongside a pH of 6.47, organic matter of 2.46 and the second-lowest reported effect count. Shaffa records the lowest conservation adoption at 0.89 strategies, alongside a pH of 4.23, organic matter of 0.53 and the

highest reported effect count on the plateau at 3.07 effects per resident. Because the survey and laboratory data were collected independently, this agreement establishes the adoption gap as a property of the landscape rather than an artefact of how residents describe their own behaviour. It also permits the gap to be quantified in physical terms: the settlements carrying the highest measured soil degradation are receiving 50% of the conservation effort of those carrying the least.

Conclusion and Recommendations

The study concludes that conservation effort, however, is inversely distributed relative to severity, with adoption declining as susceptibility increases, constrained primarily by material factors rather than awareness, as farmers adopt fewest practices in every susceptibility class. Therefore, conservation planning on the Biu Plateau should be extended to the areas projected to move into higher susceptibility and should not be relaxed on the strength of the observed recovery in vegetation cover. Since rainfall erosivity is the dominant driver and cannot be managed locally, the Borno State Ministry of Environment and the ACReSAL project should treat the strengthening of land cover and support practice as the principal available response, and should incorporate the projected susceptibility surfaces produced in this study into medium-term catchment planning so that conservation effort is directed at areas of emerging as well as existing risk.

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