

THE ONLY ASSET LEFT: FOREST COVER AND FISCAL PRESSURE IN HIGHLAND DISTRICTS

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ABSTRACT

When a large fiscal transfer ends on a statutory date, the jurisdictions losing it must find revenue elsewhere, and where the remaining monetisable asset is standing forest, termination becomes land-use policy whether or not anyone intends it. This study assembles published forest cover and cover loss for twenty-one districts, with allocation, poverty, stunting and human development data, read against a transfer schedule reaching zero in two budget years. The central highlands hold 1.11 million hectares, 37.7 per cent of provincial forest cover, and record the lowest loss rate of the three analytical regions at 0.1025 per cent against 0.4466 per cent on the opposite coast, a ratio of 4.4. The same region carries the highest poverty at 13.76 per cent, the highest stunting at 35.08 per cent and the lowest human development index, 75.64. Depletion concentrates where least remains: the two districts with the smallest cover lose 284 and 250 hectares per ten thousand hectares, against a next-highest value of 64. Forest cover is the one characteristic predicting transfer allocation, at a rank correlation of 0.514, while predicting poverty not at all. Recognising a protected ecosystem without a financing pathway leaves conversion as the only revenue instrument these districts hold.

ABSTRAK

Ketika transfer fiskal besar berakhir pada tanggal yang ditetapkan undang-undang, daerah yang kehilangannya harus mencari penerimaan dari tempat lain, dan bila aset yang tersisa untuk diuangkan adalah hutan yang masih berdiri, pengakhiran itu menjadi kebijakan tata guna lahan, disengaja atau tidak. Kajian ini menghimpun data tutupan hutan dan kehilangan tutupan yang diterbitkan resmi untuk dua puluh satu kabupaten, bersama data alokasi, kemiskinan, stunting, dan pembangunan manusia, lalu membacanya terhadap jadwal transfer yang mencapai nol dalam dua tahun anggaran. Empat temuan mengikutinya. Dataran tinggi tengah menyimpan 1,11 juta hektare, yakni 37,7 persen tutupan hutan provinsi, dan mencatat laju kehilangan terendah di antara tiga wilayah analisis, 0,1025 persen berhadapan dengan 0,4466 persen di pesisir seberangya, sebuah nisbah 4,4. Wilayah dataran tinggi yang sama menanggung angka kemiskinan tertinggi 13,76 persen, prevalensi stunting tertinggi 35,08 persen, dan indeks pembangunan manusia terendah 75,64. Penyusutannya terpusat di tempat yang tersisa paling sedikit: dua kabupaten dengan tutupan tersisa terkecil kehilangan pada 284 dan 250 hektare per sepuluh ribu hektare tutupan, berhadapan dengan nilai tertinggi berikutnya 64. Adapun tutupan hutan adalah satu-satunya ciri daerah yang memprediksi alokasi transfer, dengan korelasi peringkat 0,514, sementara sama sekali tidak memprediksi kemiskinan. Mengakui satu ekosistem lindung tanpa melekatkan jalur pembiayaan padanya

	menyisakan konversi lahan sebagai satu-satunya instrumen penerimaan yang dipegang daerah terdampak. Kata kunci: kehilangan tutupan hutan; transfer fiskal ekologis; pengakhiran transfer; kabupaten dataran tinggi; tekanan alih fungsi lahan
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1. INTRODUCTION

Forest conservation is usually analysed as a contest between environmental protection and commercial extraction. A third party is frequently decisive and rarely modelled: the subnational government that must fund public services from whatever revenue base its territory contains. Where that government's principal revenue source is a transfer, and the transfer is scheduled to end, its incentive to permit conversion changes on a known date.

The province examined here presents that configuration in an unusually explicit form. A special autonomy transfer that supplied 51.58 per cent of the provincial budget, peaking at Rp8.36 trillion, has fallen to Rp3.13 trillion and lapses under its governing statute after two further budget years (Badan Akuntabilitas Keuangan Negara DPR RI, 2020). The province contains 2.95 million hectares of recorded forest cover, a substantial share of it within a protected ecosystem that the governing statute recognises without attaching any fiscal consequence to the recognition.

The distribution of that forest across the province is the analytical starting point. Grouped into three analytical regions, the central highlands hold 1.11 million hectares — 37.7 per cent of the provincial total across only four districts — while carrying a poverty rate of 13.76 per cent, a stunting prevalence of 35.08 per cent and a human development index of 75.64, each of which is the worst of the three regions. The districts with the most to lose environmentally are the districts with the least fiscal room.

A second pattern in the same data indicates what pressure produces. Cover loss is not distributed in proportion to cover. The two districts with the smallest remaining forest lose at 284.1 and 249.7 hectares per ten thousand hectares of cover, against a next-highest value of 63.9 and a provincial average of 30.2. Depletion accelerates as the resource nears exhaustion, which is the trajectory a highland district would follow if conversion became its revenue instrument of last resort.

Four questions organise the analysis. First, how is forest cover distributed relative to fiscal capacity and social need? Second, what is the observed relationship between remaining cover and the rate at which it is being lost? Third, does the transfer allocation account for

forest at all, and in what direction? Fourth, what financing instruments exist that would make retention rather than conversion the revenue-maximising choice?

2. LITERATURE REVIEW

Ecological fiscal transfers and the pricing of retention

Nasir (2022) examines an ecological fiscal transfer scheme protecting forested areas in non-forest zones and identifies the design problem this study concerns: a subnational government bearing the opportunity cost of retention receives no fiscal recognition of it unless an instrument is built to supply one. Busch et al. (2021) survey ecological fiscal transfers across multiple jurisdictions and document both the range of designs in operation and the conditions under which they change subnational behaviour rather than merely redistributing revenue.

Colenbrander et al. (2018) address the distributional politics of climate finance and the practical difficulty of routing it to the subnational level at which land-use decisions are actually made. Best et al. (2020), examining carbon pricing efficacy across countries, establish that price instruments do change emissions trajectories, which is the necessary premise for treating retention as a monetisable activity rather than as a foregone opportunity.

The common finding across these studies is that retention has to be paid for by someone who is not the landholder, and that the payment has to reach the tier of government whose consent conversion requires. Where it does not, conservation depends on the continuing fiscal comfort of that tier — a condition that a scheduled transfer termination removes.

Conservation, livelihoods and the districts that bear the cost

Untari et al. (2022) document changing livelihood strategies in a conservation area, tracing how restrictions on resource use redirect households across fishing, farming and extraction rather than removing pressure. Akhmaddhian et al. (2023) assess the effectiveness of post-mining land rehabilitation and find implementation weak where enforcement capacity is thin. Arifanti et al. (2023) examine mangrove ecosystem management and the conditions for its restoration, establishing that conservation outcomes depend on institutional arrangements rather than on formal designation.

Lo et al. (2024) quantify the land-use consequence of an extractive expansion, tracing deforestation attributable to mining across a national dataset and identifying the concentration of loss in districts where a single industry dominates the revenue base. Andreucci et al. (2023) situate such dynamics within the political economy of extractivism, arguing that the fiscal dependence of subnational governments on extraction is itself a driver of expansion rather than merely a consequence of it.

The sand and aggregate literature supplies a closely parallel case in which a low-value bulk resource becomes fiscally important to jurisdictions with few alternatives. Torres et al. (2017) and Bendixen et al. (2019) establish the scale of the global extraction problem; Koehnken et al. (2020) document its ecological consequences; Lamb et al. (2019) trace the livelihoods omitted from the accounting; Hackney et al. (2021) find extraction far outpacing natural supply in a large alluvial system; and Haq et al. (2023) analyse the redesign of extraction policy in the Indonesian setting. The recurring finding is that where a resource is the main thing a jurisdiction can tax, it is extracted beyond the rate any environmental assessment would sanction.

Extractive fiscal regimes and what they are worth

Maroun et al. (2019), reviewing mining taxes across African jurisdictions, find the tax burden weakly related to the strength of democratic institutions and strongly related to corruption levels. Banda (2023) models the effect of fiscal regime design on mining project viability through system dynamics, establishing that regime parameters determine whether extraction occurs at all. Mudd and Jowitt (2022) reassess the sustainability of one metal's resource base; Dou et al. (2024) examine resource nationalism as a supply chain shock; Camba et al. (2022) trace how two Southeast Asian states mobilised external capital for downstream processing.

Aragon and Winkler (2023) and Corral et al. (2019) establish the general result for resource-based fiscal windfalls: effects dissipate once the windfall ends, and local outcomes improve only where administrative capacity permits conversion. Applied here, the finding cuts in an uncomfortable direction. A district that turns to forest conversion for revenue after transfer termination would be beginning a windfall cycle, not escaping one, and the evidence says the cycle ends where it began.

Fiscal termination and the behaviour it induces

Shani et al. (2023), exploiting a reform that cut grants for some municipalities and raised them for others, find grant cuts leading municipalities to raise tax rates and run larger deficits without cutting spending, with tax increases following cuts roughly twice as large as tax reductions following equivalent increases. The asymmetry means the adjustment falls on the revenue side and is not reversed, which is the behavioural premise of this study: a district facing termination looks for revenue, and looks at what it has.

Lago et al. (2024) document the asymmetric ratchet in general terms and find crowding-out of own revenue stronger in developing countries. Liu et al. (2024) identify countercyclicality rather than size as the driver of subnational overborrowing. Van Rompuy (2021) finds subnational tax autonomy promoting regional convergence across OECD countries, and Mahdavi and Westerlund (2018) find revenue capacity converging slowly, which together establish that own-revenue substitution is possible but not quick. Lewis (2023) judges the wider statutory framework unlikely to improve subnational tax mobilisation.

Ali (2019), Wijatmoko et al. (2023) and Prabowo et al. (2020) document what the transfer period produced in this territory and a comparable one, with allocation weighted heavily to infrastructure and outcomes unmatched to expenditure. Lele (2023) identifies delivery of promised outcomes as the variable separating asymmetric arrangements that work from those that do not. Chalil (2020) finds spatial interaction among Indonesian municipal fiscal decisions, which implies that one district's response to termination will condition its neighbours'.

Land, water and the systems that record change

Rusli et al. (2024), coupling hydrological and groundwater models under climate and abstraction scenarios, find confined piezometric heads declining by up to 29.51 metres by 2100 at current abstraction, with projected status dominated by anthropogenic activity rather than climatic forcing. Siriwardane-de Zoysa et al. (2021), combining satellite interferometry with policy mapping across three cities, find governance fragmented across six policy domains and subsidence framed as reversible, quasi-natural or individualised. Both establish that land and water outcomes in this region are driven by decisions taken in fiscal and administrative arenas rather than in environmental ones.

Aparcana (2017) examines the formalisation of informal resource sectors and finds that formalisation changes who captures value without necessarily changing extraction volumes — a caution relevant to any proposal that would regularise forest-adjacent activity as a

revenue measure. Bartzas and Komnitsas (2024) supply life-cycle accounting for an extractive value chain, demonstrating that the environmental cost of conversion can be quantified when someone is required to quantify it.

RESEARCH GAP

Three gaps follow. The first is that forest cover has not been analysed as a fiscal variable in this setting. It appears in environmental reporting and in the transfer literature separately, and the elementary test of whether the transfer allocation accounts for it has not been run.

The second is that the relationship between remaining cover and loss rate has not been examined at district level. If depletion accelerates as the resource nears exhaustion, then the districts currently recorded as low-loss are not stable; they are early in a trajectory that other districts have already travelled.

The third is that the scheduled termination of the transfer has not been assessed as a land-use event. The fiscal literature treats termination as a revenue problem and the conservation literature treats deforestation as an enforcement problem, and the two have not been connected in a territory where the same districts appear in both.

3. METHOD

The study is a descriptive spatial-fiscal analysis using published official data. It makes no causal claim and produces no projection of future cover loss; its purpose is to establish the joint distribution of forest, deprivation and fiscal exposure, and to characterise the loss-rate pattern already observable.

Forest cover and cover loss for 2023 by district are taken from the provincial statistical office's published table. District allocations of the special autonomy transfer for 2024 and 2026 are taken from the provincial allocation decision and the presidential regulation on transfers to regions. District poverty rates and human development indices for 2025 come from the same statistical office; stunting prevalence comes from the health ministry's nutritional status survey. Regional aggregates follow the three-region classification used in the province's own analytical documents, grouping districts by resource base and historical exposure.

Three computations were performed. Loss was normalised by remaining cover and expressed per ten thousand hectares, so that districts with very different cover can be

compared. Regional aggregates were constructed by summing cover and loss within each region and computing the ratio, rather than by averaging district rates, so that large districts are not underweighted. And forest cover was correlated with allocation, poverty and the human development index to establish which of them, if any, it tracks.

Three limitations apply. Cover loss for a single year is a noisy measure and a multi-year series would be preferable; none is published at this resolution. Cover is recorded administratively and does not distinguish primary forest from other wooded land, so loss of different ecological significance is aggregated. And the three-region classification is analytical rather than administrative, so regional aggregates depend on a grouping choice that is defensible but not unique.

4. RESULTS AND DISCUSSION

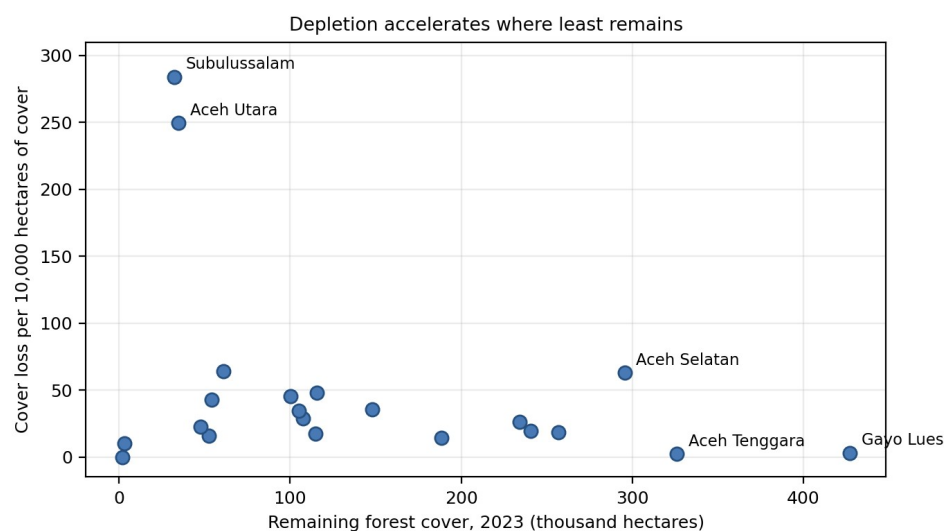


Figure 1. Cover loss rate against remaining forest cover, twenty-one districts

Finding one: depletion accelerates where least remains

Across twenty-one districts, total recorded forest cover is 2,946,382 hectares and recorded loss for the year is 8,896 hectares, an aggregate loss rate of 0.302 per cent. The distribution of that loss is highly uneven and inversely related to remaining stock. Subulussalam, with 32,064 hectares remaining, lost 911 hectares — 284.1 per ten thousand hectares of cover. Aceh Utara, with 34,675 hectares remaining, lost 866 hectares — 249.7. The next highest rate in the province is 63.9, and the median is far below that.

Both outliers are districts where cover is already close to exhausted, and both are among the four lowest in absolute cover among districts that have any. The pattern is what a depletion process produces: as the accessible stock shrinks, the remaining stock is drawn down faster, because the marginal hectare is the one nearest existing infrastructure and the alternatives have already been consumed.

The importance of this pattern is prospective rather than retrospective. The four highland districts currently record the lowest loss rates in the province, and a naive reading treats that as evidence of successful protection. The cross-sectional relationship suggests a different reading: they are at the start of the curve, and their low rates reflect abundant remaining stock rather than an institutional arrangement that would hold if the stock became fiscally necessary.

Table 1. Forest cover and cover loss by analytical region

Region	Districts	Cover (ha)	Loss (ha)	Loss rate (%)	Share of provincial cover
East-north coast	7	620,216	2,327	0.3752	21.0%
West-south coast	10	1,216,108	5,431	0.4466	41.3%
Central highlands	4	1,110,058	1,138	0.1025	37.7%
Province (21 districts with cover)	21	2,946,382	8,896	0.3019	100%

Note. Computed by the author from the provincial statistical office's 2023 forest cover and cover loss table. Two cities record no forest cover and are excluded.

Finding two: the forest and the deprivation are in the same place

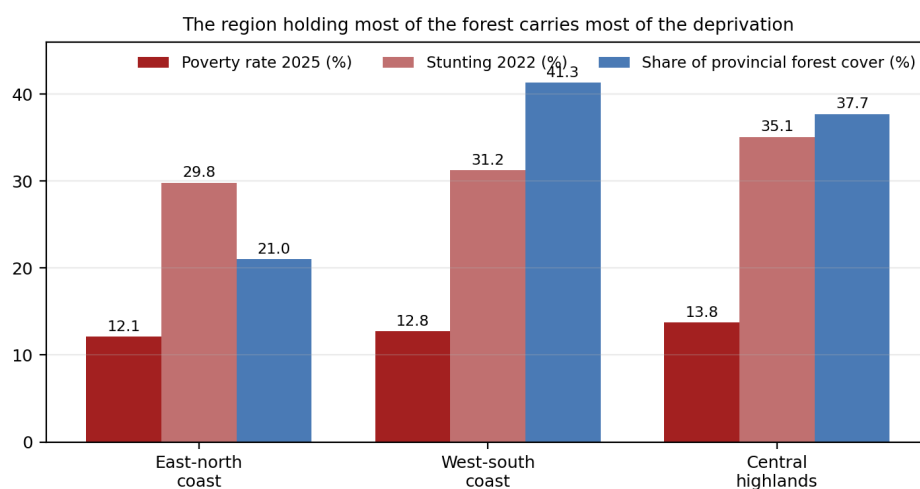


Figure 2. Regional profile: deprivation and share of provincial forest cover

The central highlands hold 37.7 per cent of provincial forest cover across four districts. The same region records a poverty rate of 13.76 per cent against 12.10 on the eastern and northern coast and 12.75 on the western and southern coast; stunting prevalence of 35.08 per cent against 29.81 and 31.25; and a human development index of 75.64 against 76.57 and 75.68. Per-capita expenditure is Rp11.042 million, the lowest of the three, Rp234 thousand below the leading region.

On every deprivation measure available at this resolution, the region that holds most of the province's forest is the worst off. That coincidence is the substantive core of this study. Conservation policy asks these four districts to forgo the conversion of an asset worth a substantial sum, and offers them no compensation for doing so, in a fiscal environment where they have less of everything else than their neighbours.

The regional loss rates make the current position clearer still. The highlands lose at 0.1025 per cent against 0.4466 on the west and south coast — a ratio of 4.4. The districts doing most of the province's conserving are the districts receiving least of its development, and they are doing it under a fiscal regime that is about to become substantially tighter.

Finding three: forest predicts the transfer, and need does not

Correlating district characteristics with the 2024 transfer allocation produces one significant result and no others. Forest cover correlates with allocation at +0.421 by Pearson with a p value of 0.058 and at +0.514 by Spearman with a p value of 0.017. The poverty rate correlates at -0.263 with a p value of 0.225, stunting at -0.089, and the human development index at +0.067; none is significant.

Forest cover is not plausibly an allocation criterion in itself. It is a proxy for territorial area, and the reading that fits the data is that the allocation key rewards extent. Whatever its merits for funding territorial administration, this has a consequence the key's designers are unlikely to have intended: the transfer that districts are about to lose is, in part, a payment for holding land, and the districts holding the most land will lose the most.

A second consequence follows for the design of any replacement. If allocation already tracks area, then an ecological fiscal transfer keyed to protected area would not be a novel principle in this system but a re-specification of an existing implicit one, made explicit and attached to a condition. Nasir (2022) and Busch et al. (2021) both document that such instruments exist

and function; what has been missing here is the recognition that the current key is already doing something adjacent to it by accident.

Finding four: the recognition without the financing

The province's protected ecosystem is recognised in the governing statute. What the statute does not contain is any fiscal consequence of that recognition — no payment for retention, no share of any environmental services revenue, no obligation on any party to compensate the districts bearing the opportunity cost. Recognition without financing places the entire cost of conservation on the jurisdictions least able to bear it, and does so at exactly the moment their principal revenue source is being withdrawn.

The sequence matters. The transfer falls from Rp3.13 trillion to zero across two budget years, having already fallen 62.6 per cent from its peak. Shani et al. (2023) establish that jurisdictions facing grant cuts raise revenue rather than cutting expenditure, and that the response is asymmetric and permanent. Andreucci et al. (2023) establish that subnational fiscal dependence on extraction drives expansion rather than merely following it. Lo et al. (2024) quantify the deforestation that follows when a single sector dominates a district's revenue base.

Nothing in this evidence predicts a sudden collapse of highland forest. What it predicts is a change in the direction of pressure at the margin: applications approved that would previously have been refused, enforcement resourced less generously, and boundary adjustments considered that were previously unthinkable. The observed relationship between remaining cover and loss rate describes where that path leads over a longer horizon than any budget cycle.

Table 2. Financing instruments available for retention, and their present status

Instrument	Basis	Present status in this territory
Ecological fiscal transfer	Transfer keyed to protected area maintained	Not established; national precedents exist (Nasir, 2022; Busch et al., 2021)
Payment for environmental services	Contract for measured retention	Recognised in principle; no revenue pathway in statute
Carbon or results-based finance	Verified avoided emissions	Not accessible at district level (Colenbrander et al., 2018)
Endowment from accumulated balances	Capitalised from unspent transfer balances	Not established; Rp5.58 trillion of balances documented
Own tax authority over land and resources	Devolved taxing power	Limited; convergence evidence favours it (Van Rompuy, 2021)

Note. Compiled by the author. Every instrument listed exists elsewhere; none is currently connected to the districts holding the province's forest.

What follows

Four measures follow. First, the implicit areal weighting in the existing allocation key should be made explicit and converted into a conditional retention payment. The arithmetic is already in the key; what is missing is the condition, and adding it converts an unexplained weighting into an instrument with a purpose.

Second, the districts bearing the retention cost should be identified and their opportunity cost estimated, since no compensation instrument can be designed against an unquantified obligation. Bartzas and Komnitsas (2024) demonstrate that the environmental cost of a conversion pathway can be computed when someone is required to compute it; the same discipline applied to retention would establish what these four districts are currently providing for nothing.

Third, the loss-rate pattern should be monitored as a fiscal indicator rather than only as an environmental one. The relationship between remaining cover and loss rate observed here is the leading indicator of exactly the process this study warns about, and it is computable annually from data the statistical office already publishes.

Fourth, and most consequentially, the transition arrangements for the ending transfer should treat highland districts as a distinct case rather than applying a uniform proportional reduction. The 2026 allocation reduced districts by an average of 11.7 per cent with a standard deviation of only 4.7 percentage points — a near-uniform cut applied to jurisdictions whose alternatives differ enormously. A coastal district losing its transfer has fisheries, plantations and ports. A highland district has coffee, horticulture and forest.

Limitations

Four limits bound the findings. Cover loss is observed for a single year and is therefore noisy; the outlier districts identified may reflect a single large event rather than a trend. Administrative cover data do not distinguish forest types, so ecologically distinct losses are aggregated. The relationship between remaining cover and loss rate is cross-sectional and does not establish that any particular district will follow the trajectory it describes. And the study observes the fiscal and environmental distributions jointly without establishing a causal link between them, which would require expenditure and permitting data that are not published at this resolution.

5. CONCLUSION

Thirty-eight per cent of a province's forest cover sits in four highland districts that record the province's highest poverty rate, its highest child stunting prevalence and its lowest human development index. Those four districts also record the province's lowest rate of cover loss, at roughly a quarter of the rate on the opposite coast. They are, at present, both the poorest and the most conserving part of the province.

Two things are about to change. The transfer that has supplied more than half the provincial budget lapses under statute within two budget years, having already fallen 62.6 per cent from its peak. And the allocation key that distributed it, which turns out to be the one thing that tracks forest cover, will distribute nothing.

The observed relationship between remaining cover and the rate of its loss describes what follows when a forest becomes fiscally necessary: the two districts in this province with least cover remaining are losing it four to five times faster than any other. That is not a prediction about the highlands. It is a description of a path that other districts in the same province have already walked, under fiscal conditions less severe than the ones arriving.

The instruments that would make retention pay exist and operate elsewhere. What this territory has is a protected ecosystem recognised in law with no financing attached, and four districts asked to hold it without being paid to, in the two years during which their budget disappears.

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Author contributions (CRediT)

Aloisius Yonathan Prakoso: conceptualisation; methodology; formal analysis; writing - original draft; writing - review and editing.

Conflict of interest

The authors declare that they have no competing interests.

Data availability

All data supporting the findings of this study are available within the article and from the publicly accessible sources cited therein.

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Declaration on the use of artificial intelligence

No generative artificial intelligence tool was used in the preparation of this manuscript.

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