Review Article

Beyond the Water Greedy Myth: A Review of Oil Palm, Transpiration, Evapotranspiration, and Watershed Hydrology for Global ESG and SDG Policy Advocacy

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Abstract

Oil palm is frequently portrayed in public debate as an inherently "water-greedy" crop that deprives surrounding ecosystems and communities of water. This article tests that narrative through a qualitative literature review rather than a systematic review, integrating recent peer-reviewed journal articles and official policy materials with a strong emphasis on sources published since 2020. The review synthesizes evidence on the soil–plant–atmosphere continuum, transpiration, evapotranspiration, and watershed hydrological response, and then evaluates how these concepts are translated—often too simplistically—into ESG, trade, and sustainability discourse. The central finding is that oil palm does use substantial water, as any high-productivity perennial canopy does, but the proposition that oil palm is uniquely or intrinsically "water greedy" is not supported as a general scientific claim. Empirical studies show that water fluxes are context-dependent and physiologically regulated. In contrast, hydrological degradation at the watershed scale is more reliably driven by land-use conversion pathways, peat drainage, soil compaction, riparian removal, inadequate ground cover, road construction, and nutrient or effluent mismanagement than by a crop-specific transpiration stereotype. The article argues for a shift from commodity demonization toward outcome-based regulation and disclosure focused on deforestation-free production, peat protection, water quality, runoff control, riparian integrity, and smallholder-inclusive transition pathways. Such a reframing is better aligned with the SDGs, the current ESG disclosure architecture, and the good-faith, non-discriminatory logic that is increasingly relevant in EU- and WTO-linked sustainability governance.

JEL Classification: Q15; Q24; Q25; Q56; F18

Introduction

Palm oil is not a marginal commodity. USDA and recent scholarly synthesis confirm that palm oil remains the world's most produced and traded vegetable oil, with Indonesia and Malaysia still dominating supply. At the same time, broader demand is tied to food systems, oleochemicals, bio-based products, and consumer goods supply chains. This economic centrality is one reason why environmental narratives surrounding palm oil rapidly migrate from science into trade policy, ESG screens, consumer campaigns, and geopolitical disputes [1].

Among those narratives, the claim that oil palm is "water greedy" has unusual rhetorical power because water insecurity has immediate moral resonance. The phrase implies that oil palm not only consumes large amounts of water but also does so in a way that is ecologically excessive, socially unfair, and agriculturally abnormal. Once circulated in that

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simplified form, it becomes easy to conflate several distinct issues: plant transpiration, total evapotranspiration, dry-season streamflow, watershed recharge, flood peaks, nutrient loading, peat drainage, and pollution from palm oil mill effluent. Scientifically, however, these are different processes operating at different spatial and temporal scales [2].

This distinction matters because current policy regimes increasingly seek measurable sustainability outcomes. The EU Deforestation Regulation is explicitly aimed at reducing the EU's contribution to deforestation and forest degradation. At the same time, current WTO-related legal analysis of palm oil disputes emphasizes the need for scientific grounding, non-discrimination, and legitimate public policy objectives in sustainability regulation. Meanwhile, the global ESG reporting architecture is evolving toward more explicit disclosure of climate- and nature-related dependencies, risks, and impacts, including water-related impacts. In that environment, weakly specified commodity narratives can become analytically costly and politically destabilizing [3].

This article, therefore, asks a narrower and more useful question: Does the scientific literature support the broad narrative that oil palm is inherently "water greedy" in a way that uniquely causes local water scarcity and environmental degradation? The thesis advanced here is that the answer is no, at least not as a generalized claim. Oil palm water use must be understood as one part of the soil–plant–atmosphere continuum and of wider land-use transitions. Hydrological harm can and does occur in some oil palm landscapes, but the decisive variables are usually conversion pathway, management quality, landscape design, soil and peat conditions, infrastructure, and watershed governance rather than an essential property of the crop itself [4].

The contribution of this article is fourfold. First, it clarifies key biophysical concepts that are often blurred in policy debate. Second, it synthesizes recent empirical evidence on oil palm transpiration, ET, and watershed outcomes. Third, it situates that evidence against comparative crop and land-use alternatives. Fourth, it translates the resulting interpretation into a global policy-advocacy frame that is consistent with ESG, SDGs, and trade-law sensitivities.

Literature Review

Conceptual Foundations

At the plant scale, transpiration is the flux of water vapor from plant tissues to the atmosphere, largely through stomata. It is not a synonym for waste. It is closely linked to carbon uptake, leaf temperature regulation, nutrient transport, and photosynthetic function. ET is broader than transpiration because it also includes soil evaporation, interception loss, and sometimes evaporation from wet surfaces and open water. Contemporary hydrology and earth-system research emphasizes that transpiration is often the dominant component of terrestrial ET, but that ET partitioning varies by vegetation structure, climate, canopy wetness, soil exposure, and land-use history [2].

This matters immediately for oil palm. A productive perennial canopy in the humid tropics will transpire substantial quantities of water, just as forests, rubber, cacao, citrus, eucalyptus, bamboo, or irrigated crop systems do under suitable climatic demand. The scientific task is therefore comparative and conditional: how large are the fluxes, how do they respond to vapor pressure deficit and soil moisture, and what do they imply at stand and watershed scale? The literature correctly notes that one cannot infer catchment degradation from the presence of transpiration alone [5-8].

The soil–plant–atmosphere continuum is a more appropriate conceptual frame. Water availability to roots depends on rainfall regime, infiltration, water-table position, texture, rooting depth, and soil hydraulic properties. Water export to the atmosphere depends on radiation, aerodynamic demand, canopy development, and stomatal regulation. Research on plant hydraulics and global transpiration datasets shows that vegetation is not a passive pump: transport pathways and stomatal responses constrain water loss, especially under stress. This is why high transpiration is compatible with strong physiological regulation rather than evidence of unbounded extraction [2].

Recent oil palm studies are consistent with that general framework. The 2025 sap-flux study on oil palm reports detailed within-palm variation in flow density and explicitly re-examines the hypothesis that high transpiration could be explained by substantial internal water storage. More importantly for this review, the paper treats oil palm water use as a measurable physiological process—not as an inherently pathological trait. Drought and haze studies likewise show adaptive stomatal behaviour and water-use-efficiency responses rather than a simple pattern of endless water demand [9].

Hydrological Foundations

At the watershed scale, the meaningful variables extend beyond crop transpiration. Streamflow response depends on how rainfall is partitioned into interception, infiltration, overland flow, shallow subsurface flow, groundwater recharge, baseflow, and channel routing. Land-cover change modifies those pathways not only through changes in vegetation water use but also through canopy removal, soil disturbance, compaction, drainage, terrace and road networks, and riparian alteration. Decades of forest hydrology research broadly show that deforestation tends to increase water yield and peak flows. In contrast, afforestation or reforestation often reduces annual runoff but can improve other ecosystem functions. This general principle is essential because many claims

about oil palm water greed fail to distinguish between the hydrological effects of replacing forest with plantation and the physiology of the plantation once established [10].

Recent watershed research in oil palm regions illustrates this point. The 2024 Science of the Total Environment study on the Kais River watershed links oil palm development to higher surface runoff, sediment, nitrogen, and phosphorus, but the actual mechanism analyzed is land-cover conversion and watershed reorganization, not a simple conclusion that palm transpiration itself dries out the basin. The study explicitly frames the issue as ecohydrologic modelling of large-scale land-cover change [4].

The 2020 Journal of Hydrology: Regional Studies paper from Tabasco, Mexico, reaches a similarly careful framing. It examines hydrologic impacts and trade-offs associated with oil palm development at the watershed scale. It underscores the scarcity of small-scale hydrology claims that can be generalized directly to runoff behaviour. In short, the literature itself is cautious: hydrological outcomes are context-dependent, and many are mediated by landscape transformation rather than by a single crop-coefficient narrative [11].

Research from Sumatra is especially important because it links local perception, field science, and watershed modelling. Ecology and Society documented that villagers connect flooding and altered river behaviour to rapid land-use change. At the same time, hydrological modelling work from Jambi indicates that maintaining sufficient forest cover is central to sustaining water-flow regulation under mixed plantation landscapes. That evidence does not exonerate poor plantation development; rather, it shows that the analytically relevant issues are catchment composition and management thresholds, not a simplistic dismissal of oil palm as uniquely water-greedy [12].

Comparative Crop Perspective

The comparative perspective is often missing from public discourse. Yet from a sustainability standpoint, one must always ask: compared to what? Recent reviews of global vegetable oil systems emphasize that oil palm's land productivity is substantially higher than that of soybean, rapeseed, and sunflower. That does not eliminate environmental risk, but it does mean that replacing palm oil one-for-one with lower-yield oil crops can relocate or enlarge water, land, and biodiversity burdens elsewhere. In policy terms, a hydrological critique of palm oil that ignores land efficiency is incomplete [13,14].

This is particularly relevant when discussing water. Lower-yield alternatives can reduce the share of environmental pressure per hectare only to increase total pressure through expansion elsewhere [15]. Recent scholarship on zero-deforestation commitments and broader sustainability strategies, therefore, tends to favour yield improvement on existing land, restoration, set-asides, and stronger landscape governance over crude commodity substitution. Nature Sustainability shows that climate-smart intensification could spare large areas of forest and peatland. In contrast, other work shows that strategic set-asides and tree-island restoration can improve biodiversity and ecosystem functioning without sacrificing core productivity [14,16].

This comparative logic is especially important for policy advocacy in the EU and in ESG dialogue. A narrative that singles out palm oil as water-greedy in isolation from soybean, rapeseed, sunflower, or other plantation systems risks producing a distorted sustainability hierarchy. A more credible position is that all large-scale commodity landscapes have hydrological externalities; the task is to identify the least damaging pathways per unit of useful output and to discipline land-use change, drainage, and pollution across commodities on a scientifically comparable basis [17].

Policy and Sustainability Context

The literature's broad argument is surprisingly well aligned with current policy evolution. The EUDR does not define oil palm as a water-greedy crop; it seeks to reduce the EU's contribution to deforestation and forest degradation, thereby reducing greenhouse gas emissions and biodiversity loss. This is a land-use governance instrument. That architecture is consistent with much of the hydrological literature because it focuses upstream on conversion pathways rather than pretending that plant physiology alone explains watershed degradation [3].

The WTO-related palm-oil disputes reinforce a second lesson. Trade-restrictive sustainability interventions must be justified through consistent methodology, legitimate environmental objectives, and non-discrimination. Scholarly analysis of the disputes makes clear that the EU's climate-policy objectives can be legitimate while its methodological and implementation details remain contestable. For advocates of sustainable oil palm, this implies that the most robust case is not "trust us, palm oil is harmless," but rather "regulate verified outcomes and apply the science consistently across commodities" [17].

ESG and disclosure systems are moving in the same direction. IFRS S2, GRI 303, TNFD, and CSRD-related reporting all strengthen expectations that firms identify material environmental dependencies, risks, impacts, and management responses, including those associated with water and nature. For oil palm, that means better disclosure on riparian protection, peat water-table management, runoff mitigation, nutrient losses, effluent

control, flood risk, and smallholder inclusion, rather than reliance on commodity stigmas that are difficult to audit [18,19].

Method

This study is a qualitative literature review, not a systematic literature review. The goal is interpretive synthesis rather than exhaustive screening in accordance with PRISMA protocols. That choice is justified by the interdisciplinary nature of the question, which crosses plant physiology, ecohydrology, watershed science, agronomy, sustainability governance, and trade law. A strict systematic protocol would be useful for narrower subquestions, such as a meta-analysis of oil palm ET under specific climates, but it would be less appropriate for integrating biophysical and policy literatures into a single advocacy-oriented argument [20].

The source base was purposively assembled from recent peer-reviewed journal articles in ecohydrology, hydrology, agronomy, sustainability science, trade law, and environmental governance, as well as official institutional materials from the European Commission, RSPO, IFRS, GRI, TNFD, UN SDG platforms, and WTO-related official case pages, where accessible. Priority was given to studies published since 2020, while retaining selected pre-2020 foundational studies that remain methodologically central to oil palm sap flow, ET, and watershed hydrology [3].

The review used thematic coding across four clusters: plant-scale water fluxes; stand-scale ET and water-use efficiency; watershed- and catchment-scale hydrological response; and policy translation into ESG/trade/SDG frameworks. The resulting interpretation does not claim universal causal certainty across all production regions.

Instead, it identifies which propositions are strongly supported, which require contextual qualifiers, and which remain oversimplified or weakly evidenced [4].

A qualitative review also requires discipline against one-sided selection. For that reason, the manuscript does not deny that hydrological degradation can occur in oil palm landscapes. On the contrary, it highlights documented cases of increased runoff, sedimentation, nutrient loading, and altered freshwater integrity, as well as peat-related risks. The point of analysis is narrower: these harms are real, but their causes are better explained by land-use transition and management mechanisms than by the vague label of intrinsic water greed [4].

Results

Theme one

The first thematic result is that the "water greedy" narrative confuses large water flux with abnormal or unregulated water use. Oil palm is a high-biomass, highly productive perennial crop in warm, humid climates. It therefore transpires significant amounts of water, as do forests and many other productive perennial systems. Contemporary ecohydrology insists on analysing those fluxes through canopy structure, stomatal behaviour, aerodynamic demand, and rooting environment, not through slogans. Oil palm sap-flow and WUE studies support this framing by showing measurable regulation under drought and haze conditions [2,21-23]. Table 1 summarizes transpiration and evapotranspiration across crops and study contexts.

Table 1: Transpiration and Evapotranspiration across Crops and Study Contexts.

Land Use or Crop	Indicative Water-Flux Pattern	Context and Interpretation	Main Implication
Oil palm in humid tropical mineral soils	Moderate to high transpiration and ET, but physiologically regulated; values overlap with other productive tropical canopies	Recent sap-flow and ET studies treat oil palm as a regulated perennial canopy rather than a limitless water sink [9].	High water flux is not evidence of abnormal water greed by itself
Oil palm under drought, haze, or El Niño stress	Reduced ET or altered WUE through stomatal regulation and stress responses	Stress studies show adaptation, not unlimited extraction [24].	Water use must be read together with atmospheric demand and stress physiology

Oil palm on marginal lands requiring water-table maintenance	Potentially high blue-water requirement under special edaphic constraints	This is a real planning risk, but not representative of standard rainfed humid systems [25].	Do not generalize marginal-land irrigation cases to all oil palm
Tropical forest	Often high ET owing to tall canopies, deep roots, and strong coupling with the atmosphere	Global reviews stress that forests are also major evapotranspirers [20].	Converting forest to plantation cannot be analyzed only as a “less water versus more water” story
Rubber and other plantation tree crops	Context-dependent ET and transpiration that can be substantial and hydrologically consequential	Comparative plantation studies show that water-flux concerns are not unique to oil palm [26].	Cross-commodity comparison is essential
Lower-yield annual oil crops	Often lower per-hectare canopy water flux, but much lower oil yield per hectare	Comparative vegetable oil work highlights displacement risk when land-hungrier crops replace palm oil [13].	Policy should assess impacts per unit output as well as per hectare.

The literature is especially important here because it compiles evidence that oil palm's daily water use and ET in humid tropical settings commonly fall within broad ranges that overlap with those of other canopied tropical systems and are far below those of extremely high-flux taxa such as bamboo. The literature also emphasizes that oil palm water loss is governed by stomatal control and that plant-scale values cannot be mechanically translated into watershed-scale claims of scarcity. That is a strong scientific starting point for correcting public narratives [27-30].

A necessary qualifier concerns marginal lands and irrigation. The 2022 Agricultural Water Management paper on oil palm grown on marginal lands reports substantial blue-water requirements under specific conditions where maintaining a high water table becomes necessary. This is an important warning for expansion planning. But it is not representative of mainstream rainfed oil palm on humid mineral soils, and using such marginal-land cases to characterize all oil palm would be a category error [22,25].

Theme Two

The second thematic result is that many documented hydrological problems in oil palm landscapes arise from conversion pathway and management quality rather than from plant transpiration alone. The Kais watershed study found higher runoff, sediment, and nutrient export after plantation establishment. Yet the causal chain examined by the authors runs through major land-cover change, including conversion of primary rainforest and wetlands, and the study ends by calling for broader water-resource management across multiple institutions. In other words, the evidence points to a failure of watershed governance and the need for ecological redesign, not to a standalone physiological indictment of oil palm [4,27,31-33]. Table 2 summarizes watershed hydrological outcomes by land use and conversion pathway.

Table 2: Watershed Hydrological Outcomes by Land Use and Conversion Pathway.

Conversion or Land-Use Condition	Hydrological Outcome Often Observed	Mechanism Emphasized in the Literature	Policy Reading
Forest or wetland converted to oil palm without strong safeguards	Higher runoff, sediment, and nutrient export in some watersheds	Land-cover change, disturbed soils, roads, riparian loss, and management gaps	Regulate conversion pathway and watershed design, not just crop identity [4]
Mixed watersheds with declining forest cover	Reduced water-flow regulation and altered runoff/baseflow relationships	Forest cover thresholds matter for infiltration and buffering	Forest retention remains central in oil palm landscapes [34]
Drained peatland oil palm	Water-table decline, subsidence, fire susceptibility, and long-term instability	Drainage-induced peat oxidation and hydrological disruption	Peat is a distinct red-flag case requiring separate regulation [35]
Plantation landscapes with poor effluent and nutrient management	Water-quality deterioration in streams and rivers	POME discharge, nutrient leaching, and local freshwater disturbance	Strong mill and basin water-quality controls are essential [36]
Oil palm landscapes with restoration, set-asides, and tree islands	Better biodiversity and ecosystem functioning without major production sacrifice	Structural complexity, riparian restoration, and spatial planning	Hydrological and ecological performance can be improved within working landscapes [37]

Theme Three

The third thematic result is comparative. When oil palm is benchmarked against other major vegetable-oil systems, its exceptionally high oil yield per hectare becomes central to environmental evaluation. Recent comparative studies argue that the appropriate sustainability question is not only "what are the impacts per hectare?" but also "what are the impacts per tonne of useful oil and what additional land would alternatives require?" Under that lens, indiscriminate displacement of palm oil can shift deforestation and hydrological burdens rather than eliminate them [13,43-46].

This does not imply that oil palm is automatically sustainable. Instead, it means that strong sustainability policy should aim at no-deforestation production, peat exclusion or no-drainage alternatives, riparian protection, runoff control, restoration, and yield improvement on existing land. Nature Sustainability research on climate-smart intensification, set-asides, and restoration in oil palm landscapes suggests that this combination is not only desirable but feasible. Such a package is more scientifically defensible than the crude narrative that the crop should be disfavoured because it is supposedly uniquely thirsty [16,29,47-50].

Theme Four

The fourth thematic result concerns discourse translation. Public narratives often collapse three distinct issues into one: deforestation, water use, and water pollution. Yet the policy instruments that matter most increasingly separate them. EUDR targets deforestation-free supply chains. GRI 303 emphasizes material water impacts and management. TNFD focuses on nature-related dependencies and risks. RSPO's current standards architecture is framed around avoiding environmental and social harm through auditable requirements and continuous improvement. Scientifically and institutionally, then, the global system is moving toward outcome-specific governance rather than commodity-level moral shorthand [3,51-54].

Table 3: summarizes some policy instruments and implications.

Instrument or Framework	What it Actually Targets	Relevance to the Water-Greedy Narrative	Practical Implication for Advocacy
EUDR	Deforestation-free and degradation-free supply chains	Supports land-use accountability, not simplistic crop stereotyping	Argue for traceable no-deforestation plus hydrological stewardship metrics [3]
WTO jurisprudence and related analysis on palm-oil disputes	Legitimacy, scientific grounding, and non-discrimination of sustainability measures	Weak commodity caricatures are less defensible than outcome-based standards	Frame advocacy around measurable hydrological outcomes and parity across crops [17]
RSPO standards	Auditable sustainability requirements and improvement	Better suited to managing riparian, social, and no-harm outcomes than slogans	Use certification as a delivery tool for water stewardship and basin governance [55]
GRI 303	Disclosure on material water impacts and management	Converts vague debate into reportable water indicators	Encourage basin-level water accounting and quality indicators [56]
TNFD	Nature-related dependencies, impacts, risks, and opportunities	Embeds water within a broader nature-risk lens	Link oil palm hydrology to nature-positive landscape strategies [57]
IFRS S2 and CSRD-related reporting	Climate and broader sustainability disclosure architecture	Pushes firms toward auditable environmental risk management	Tie palm-oil advocacy to risk-adjusted, decision-useful disclosure rather than narrative warfare [18]

The sustainable oil palm community should welcome that institutional shift. If regulation becomes more outcome-based, then rebutting the "water greedy" myth does not mean arguing for deregulation. It means insisting that water claims be tied to measurable hydrological evidence: dry-season baseflow, water-table management, riparian width, turbidity, nutrient concentrations, flood metrics, soil cover, road drainage, and peat depth or oxidation status. Those are indicators that can be verified and improved. By contrast, "water greedy" is too vague to govern well [17].

Discussion and Analysis

The synthesis of plant physiology and catchment hydrology yields a clear analytical conclusion. Oil palm is a water-using crop, but that statement has little independent explanatory value because all productive wet-tropical canopies are water-using systems. The decisive scientific problem is scale transition. At the palm scale, transpiration reflects physiological function. At the stand scale, ET depends on canopy and soil exposure. At the catchment scale, runoff and baseflow depend strongly on infiltration capacity, soil disturbance, drainage, roads, riparian integrity, and remaining forest cover. The "water greedy" narrative fails because it jumps from plant water use to broad claims of watershed degradation without tracing the intermediate mechanisms [2,4,27,28,58,59].

This also explains why some empirical studies appear negative, even as the broader narrative remains misleading. Forest conversion to oil palm can indeed worsen hydrological outcomes. But the correct interpretation is usually "forest-to-plantation conversion under specific management conditions increased runoff or degraded water quality," not "oil palm is inherently greedy for water." Indeed, classical hydrology would often predict that lower forest cover could increase water yield while simultaneously worsening peaks, sediment, and water quality.

That set of outcomes is entirely compatible with the ecohydrological literature and directly contradicts overly simple scarcity rhetoric [10,60-63].

A second interpretive point concerns justice and smallholders. If policy actors rely on oversimplified narratives, the burden often shifts toward smallholders who lack the capital to comply with rapidly changing standards but are not the main drivers of hydrologically destructive roads, mills, peat drainage, or weak landscape planning. Recent work on smallholder sustainability and livelihoods warns against that mistake. Global policy advocacy should therefore distinguish between outcome-based environmental discipline and blanket reputational penalties that can worsen rural inequity without improving basin hydrology [64-66].

For ESG and SDG governance, this has major implications. The most defensible water-related ESG position on oil palm is not a blanket positive claim, nor is it a blanket negative claim. It is a conditional claim: oil palm production is compatible with strong water stewardship where expansion is deforestation-free, peat drainage is avoided or tightly managed, riparian systems are protected, ground cover is maintained, roads are hydrologically designed, effluent is controlled, and monitoring is transparent. That approach aligns much better with SDG 6 on water, SDG 12 on responsible production, SDG 13 on climate, and SDG 15 on terrestrial ecosystems than slogan-based exclusion [66-69].

For the EU-WTO interface, the key lesson is methodological discipline. If environmental measures are framed around measurable outcomes in deforestation, land-use change, peat protection, and water quality, they are intellectually stronger and more politically defensible than discriminatory or weakly justified commodity narratives. The 2025 trade-law analysis of the palm-oil disputes is instructive precisely because it stresses scientific support, good faith, and non-discrimination. Producers and regulators should use that opening to redesign debate away from caricature and toward measurable environmental performance [17,70-72].

The policy advocacy message, then, should be globally legible: stop asking whether oil palm is "water greedy" in the abstract and start asking whether a given oil palm landscape meets auditable thresholds for hydrological stewardship. This is the framing that can bridge producing-country interests, investor due diligence, certification systems, and European regulatory expectations. It is also the framing most likely to survive serious peer review [55].

Open Questions and Targeted Empirical Studies

Several issues remain under-researched and should become priorities for future empirical work.

First, more harmonized field comparisons are needed between oil palm, rubber, cacao, secondary forest, restored riparian corridors, and mixed agroforestry under identical climatic and edaphic conditions. Many current comparisons still suffer from site heterogeneity [2].

Second, peatland hydrology remains too often separated from mainstream commodity comparisons. Future studies should integrate water-table depth, peat oxidation, fire risk, and nutrient mobility into basin-scale water stewardship metrics suitable for certification and ESG disclosure [35].

Third, more paired watershed studies are needed that explicitly disentangle the relative contribution of canopy ET, road density, compaction, mill effluent, fertilizer losses, and riparian-width decisions. This is the empirical frontier most directly relevant for policy design [4].

Fourth, smallholder-inclusive hydrological monitoring is still thin. If global regulation becomes more outcome-based, then low-cost hydrology and water-quality monitoring systems for smallholders and cooperatives will be essential to avoid exclusionary governance [64].

Conclusion

This qualitative literature review finds that the claim that oil palm plantations are inherently "water greedy" in a way that generally causes surrounding water scarcity and environmental degradation is scientifically overstated and often misleading. Oil palm uses water through transpiration and evapotranspiration, as any productive tropical perennial canopy does. The empirical literature does not support reducing watershed hydrology to that single fact. Instead, hydrological outcomes are shaped by land-use transition pathways, prior forest cover, peat drainage, soils, topography, infrastructure, riparian management, canopy age, ground cover, and water-quality governance.

A more accurate policy statement is therefore this: oil palm can be associated with hydrological harm when developed through ecologically damaging conversion, drainage, and poor management, but it should not be represented as uniquely or universally water-greedy by definition. That distinction is not semantic. It changes what should be regulated, financed, audited, and reported.

For global policy advocacy, five recommendations are as follows. First, replace commodity-level stigma with outcome-based hydrological indicators. Second, prioritize no-deforestation and no-harm conversion pathways, especially excluding or strictly regulating peat drainage. Third, scale riparian reserves, road drainage design, ground cover maintenance, sediment control, and nutrient/effluent management as standard practice. Fourth, align water stewardship metrics with GRI 303, TNFD, IFRS-linked climate and nature risk management, and certification pathways. Fifth, protect smallholder inclusion by supporting compliance finance, extension services, and traceability systems rather than shifting the burden of narrative risk onto the least-capitalized actors.

In short, the strongest pro-science and pro-sustainability position is neither denial nor demonization. It is precision. Oil palm should be judged by where it is planted, what it replaced, how it is managed, how its watershed is protected, and how honestly its risks are disclosed. That is the path most consistent with strong ESG performance, credible SDG alignment, and fair, scientifically defensible global governance.

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