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Mapping the Ontology and Epistemology of Research Into Forest Carbon Offsetting in Developing Countries

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ABSTRACT

In this paper, we consider knowledge cumulation in one of the most polarized areas of environmental governance research: forest carbon offsetting in developing countries. Our specific contribution is a critical review of the ontological and epistemological positioning of 31 studies published in the peer-reviewed literature on forest carbon offsetting in Uganda. At the surface, differences appear related to methodological gaps along the qualitative-quantitative divide. However, probing deeper suggests a lack of agreement on fundamental ontological and epistemological issues, which challenges traditional understandings of scientific knowledge cumulation. Among our key findings is that research into forest carbon offsetting in Uganda is predominated by epistemologies we characterize as neopositivist (approximately half) and neo-Marxist overdetermination (approximately one-third). Structural ontologies were significantly more frequently identified in our critical review than agentic ontologies, while structure–agency balancing ontologies were the least represented. Notably, research most critical of forest carbon offsetting was characterized by an epistemology of neo-Marxist overdetermination and structural/synchronic ontology. While recognizing the limits of our critical review into forest carbon offsetting in Uganda, knowledge cumulation appears to be frustrated by a lack of agreement on fundamental ontological and epistemological presuppositions. Nonetheless, given the polarized debate on forest carbon offsetting, delineating such fundamental differences may help lay the groundwork for promoting dialogue between different research traditions. But such epistemic fragmentation or diversity may not in itself constitute epistemic justice, which requires additional attention to broader power imbalances involved in the conduct of environmental governance research in developing countries.

1 | Introduction

In this paper, we consider the production and cumulation of research knowledge in one of the most polarized areas of environmental governance research: forest carbon offsetting in developing countries. This has been heralded as having the potential to attract financing toward the improvement of rural community livelihoods and the conservation of biodiversity while addressing climate change mitigation (van der Gaast et al. 2018). The idea behind carbon offsetting is that rich countries and firms might allay part of the cost of reducing their greenhouse gas emissions by investing in projects in developing countries where costs are lower; emission reductions or sequestration resulting from such investments are credited to the investing country or firm (Lovell 2010). Carbon offsetting mechanisms have been developed under the Paris Agreement of the United Nations (UN) climate change regime as well as on the so-called voluntary carbon market (Ahonen et al. 2022;

Kreibich 2024). It is also expected to contribute to the new collective quantified goal on climate finance for developing countries (Espelage et al. 2022).

But many questions have been raised about the capacity of forest carbon offset systems to achieve climate and development objectives (Aggarwal and Brockington 2020; Böhm and Dhabi 2009; Dube and Chatterjee 2022; Green 2023; Ruseva et al. 2017). Indeed, the debate is polarized: is offsetting a responsible way to address emissions that are costly or politically difficult to reduce domestically/in-house, or is it a flawed form of international cooperation—if not neocolonialism? Research like that reviewed here informs whether forest carbon offsetting should be supported or phased out.

This paper is motivated by questions about how knowledge about forest carbon offsetting is produced and whether knowledge is progressing, in line with this special issue's focus. As Newig and Rose (2025, 2) explain, "Cumulative knowledge builds on previous achievements in a way that the understanding of governance arrangements and their effects is growing and deepening by adding to, challenging, or confirming existing research." The polarized debate on forest carbon offsetting may be attributed to fundamental differences in research ontology and epistemology—presuppositions that influence how research is conducted (Hall 2003; Moses 2020). Strong differences in such presuppositions may indicate that knowledge about forest carbon offsetting in developing countries is becoming a "fragmented adhocracy" where different research communities perpetuate "their own common concepts, research objects and methodological approaches" (Newig and Rose 2020, 669). Another view is that such differences should be valued as "epistemic diversity" (Solomon 2006). But as Solomon (2006, 25) asks, "If diversity is good, how much diversity is best?"

We submit that mapping out the extent and character of ontological and epistemological presuppositions underpinning research into forest carbon offsetting in developing countries might inform discussion about whether knowledge is cumulating, fragmenting, or diversifying. Such understanding might also help researchers identify areas of disagreement and agreement in a more transparent manner, allowing greater opportunity for dialogue to emerge. Our specific contribution regards forest carbon offsetting in Uganda, where the debate has been particularly acute given the relatively large number of carbon offset projects there. In this paper, we undertake a critical review of the ontological and epistemological positioning of 31 studies published in the peer-reviewed literature about forest carbon offsetting in Uganda.

We begin by unpacking research ontologies and epistemologies, identifying six ontological categories and three epistemological postures that guide our critical review. The second section outlines our methodology. The third presents our categorization of the studies across ontological and epistemological categories. The final section discusses findings in relation to debates on fragmentation, diversity, and epistemic justice regarding forest carbon offsetting in developing countries, but also environmental governance more broadly.

2 | Unpacking Ontologies and Epistemologies

2.1 | Research Ontologies

Ontology refers to the basic assumptions "about what kinds of things or substances there are in the world" (Benton and Craib 2010, 235). While different approaches exist, we draw on Grabs et al. (2021), who distinguish different ontological positions along synchronic-diachronic and structure–agency continua in the field of private governance. We reserve discussion of causal ontologies for our later review of research epistemologies.

2.1.1 | Synchronic and Diachronic Ontologies

A first ontological dimension distinguishes research into forest carbon offsetting according to its temporal perspective. Synchronic ontologies tend to treat social phenomena as they are, with little attention to history or prospects for future change. As Cox and Schechter (2003, 151) submit: "[The synchronic dimension] is the realm of problem-solving within the prevailing order of things." In contrast, diachronic ontologies situate empirical research in time to ask "how the existing order came into being, what are its internal contradiction, and how may it be changed" (Cox and Schechter 2003, 151). While inspired by Braudel's (1980) historical concept of the *longue durée*, diachronic research ontologies can also be future-oriented, asking how a specific policy intervention might seed transformative change (Bernstein et al. 2000).

2.1.2 | Structure and Agency

A second ontological dimension is the structure–agency debate. At one end are ontologies emphasizing individual agency, focusing on individual actors with limited attention to political institutions or broader social structures. Synchronic/agentic ontologies often assume rational choice theory or bounded rationality, aligning with neoclassical economic theory and political behavior models (Oppenheimer 2008). A key assumption is that agent preferences are stable, consistent, and exogenous. The diachronic version, however, questions fixed economic and political preferences, allowing for "incremental change in actors' preferences, attitude, knowledge and interactive patterns" through learning and policy experimentation (Grabs et al. 2021, 1192). Institutions, when considered, are seen as created by agents in response to governance gaps (Bernstein and Cashore 2007).

At the other end of the spectrum are theories stressing structural constraints. For example, structural Marxism assumes that a global capitalist structure dominates over all behavior (Wendt 1987). While neo-Gramscianism also traces its origins to Marx, it accords more attention to ideational features of actors operating under capitalism (Morton 2003). While this propensity for stronger agency renders it more diachronic than structural Marxism, neo-Gramscianism is still "inherently more pessimistic about the ability of civic actors to change the hegemony" of global capitalism than more agentic ontologies (Grabs et al. 2021).

What about a middle ground? The sociologist Anthony Giddens (1984) proposed structuration theory, which transcends the duality by emphasizing reflexive interaction between structure and agency through institutions; these serve as "social environments" where agents internalize norms through repetitive practice (Johnston 2001; Wendt 1987). The political science literature recognizes different institutionalisms (Hall and Taylor 1996). Like Grabs et al. (2021), we associate historical institutionalism (and to a lesser degree sociological institutionalism) with diachronic approaches. Research here tends to explain behavior through a "logic of appropriateness" (March and Olsen 1998). In contrast, these same authors assert that rational choice institutionalism tends toward a more synchronic ontology; here, policy actors are assumed to adhere to a "logic of consequences." Unlike individualist rational choice theory, it draws attention to how rules structure choices and information.

2.2 | Research Epistemologies

Epistemology is defined by Benton and Craib (2010, 233) as a "philosophical enquiry into the nature and scope of human knowledge, concerned with distinguishing knowledge from belief, prejudice and so on." In this paper, we are concerned with research epistemologies through which social scientists claim to produce new knowledge about forest carbon offsetting. Research epistemologies should not be conflated with Foucault's concept of historical *epistemes* (Dews 1992) nor traditional and local knowledge (Mazzocchi 2008).

A number of different research epistemologies are identified in the literature on environmental politics and governance. For example, Frank Geels identifies positivism, pragmatism, critical realism, interpretivism, and postmodernism (Geels 2022; Geels et al. 2016). But other scholars suggest that these analytical distinctions are less clear-cut. For example, Susen (2015, 40) suggests similarities between interpretivism and postmodern epistemologies in claiming that "the validity of all knowledge claims is contingent upon the spatiotemporal specificity of the sociohistorical context in which they are raised."

The distinction between neo-Marxism and postmodernism is also blurred.[1] Both might be described as "structural epistemologies" that emphasize that social structures shape the production of scientific knowledge to a greater extent than empirical observation (Eyers 2014; Gibson et al. 2000). However, for reasons we elaborate below, we distinguish neo-Marxist overdetermination from other structural, postmodern epistemologies. The former traces its origins to Freudian psychoanalysis, where "overdetermination" refers to a situation where a social phenomenon can be attributed to multiple different causes (Strawbridge 1984). It was introduced into neo-Marxist analysis in the 1960s by Louis Althusser in an effort to remedy the determinism of classic Marxism. However, we submit that neo-Marxist overdetermination privileges economic structures in its final interpretation of social phenomena in a way that is distinct from other structural epistemologies associated with postmodernism. It should also be borne in mind that there are different types of neo-Marxism. For example, analytical Marxism continues to embrace a neopositivist epistemology (Muntaner et al. 2015).

Among these different research epistemologies, our critical review identifies three among published research into forest carbon offsetting in Uganda: neopositivism, interpretivism, and neo-Marxist overdetermination. Among the different criteria distinguishing them, for reasons of space, we focus on their empirical strategy, causal ontologies, as well as approaches to generalization (Table 1). However, these epistemological categories are ideal types, and boundaries between them are permeable and subject to interpretation.

2.2.1 | Empirical Strategy

We begin by describing the empirical strategies of the three epistemological postures.

First, neopositivism focuses on measuring observable social behavior while emphasizing the importance of causal inferences and falsification strategies to explain social phenomena (Lawler and Waldner 2023). Consequently, it prizes objectivity and reliability, which also ensures that research findings might reliably be replicated regardless of who undertakes it. As the name suggests, neopositivism evolved out of positivism, which itself grew out of efforts in the 19th century to establish social scientific "laws" akin to the natural sciences (Jackson and Dolan 2021). In contrast, neopositivism concedes that it is impossible to test all knowledge claims and that researchers should be satisfied with making causal inferences restricted by scoping conditions (Gefen 2019; Hawkesworth 2015).

In contrast to neopositivism, interpretivism focuses on the intersubjective "systems of meaning in which agents find themselves" (Norman 2021, 938). The primary task of interpretivist research is to gain an authentic understanding of social meanings from actors' points of view. Two different interpretations of

TABLE 1 | Characteristics of different research epistemologies observed.

Characteristic	Neopositivism	Interpretivism	Neo-Marxist overdetermination
Empirical strategy	Objective behavior	Social meanings	Dialectical approach including objective behavior and social meanings
Causality	Constant conjunction, causation, and combinatorial causation	Combinatorial causation and constitutive causation	Complex causation though economic forces retained as "structure in dominance"
Generalization	Limited generalization/ systems resonance	No generalization/ transferability	Analytic generalization

the ontological status of social meanings are generally identified (Scauso 2020). First are what might be referred to as "rooted meanings," which suggest that ideas are social structures that are *partially independent* of individual actors involved. A second ontological position considers ideas to be more free-floating and questions efforts to anchor them in intersubjective social structures. Instead of objectivity and reliability, interpretivists emphasize credibility, reflexivity, and transparency (Schwartz-Shea 2015). Perhaps most important is credibility, which is gained through research techniques such as prolonged engagement and participant observation. The goal is to generate "thick description"—an interpretation that considers the context, meaning, and intentions behind observed behavior.

Finally, we turn to neo-Marxist overdetermination, where there is less explicit emphasis on empirical research strategy. Indeed, structural epistemologies often question whether empirical research that is not attentive to social structure is a legitimate means of producing knowledge in the first place; neo-Marxist overdetermination questions the ability to identify causal factors shaping social phenomena, as discussed in the next section. Nonetheless, Susen (2015, 68–69) suggests that methodologies used in postmodern research informed by structural epistemologies demonstrate a dialectical approach that allows cross-validation between observed behavior and social meanings. Such a dialectical method resonates with the complex causality underpinning neo-Marxian overdetermination, given its emphasis on how Susen (2015, 69) "multiple elements simultaneously affect the development of social constellations."

2.2.2 | Causal Ontologies

The epistemologies observed in research into forest carbon offsetting have different understandings of causality.

Neopositivism emphasizes developing methods to observe causal relationships and assess the validity of causal inferences. For example, in standard regression analysis, researchers are interested in isolating an explanatory variable to estimate its average effect on an outcome (see Meuleman et al. 2014). But qualitative methods might also be used to generate causal inferences, although the nature of causation differs. While quantitative neopositivists tend to treat causal factors as discrete variables and focus on constant conjunction, qualitative neopositivists focus on causal combinations associated with particular outcomes (Beach and Pedersen 2019; Mahoney et al. 2013).

Interpretivists question the determinism associated with constant conjunction causation, arguing that social phenomena are complex and cannot be reduced to simple causal relationships. Indeed, Geels (2022, 4) asserts that interpretivists reject causation. However, others argue that interpretivists do not reject all forms of causality, only constant conjunction causation: "[interpretivism] seeks explanations that are unique, contextualized deeply into both the limited temporal and spatial world, but also unique to the researcher's own frame of mind" (Lawler and Waldner 2023, 236). In contrast to neopositivism, interpretivists are more open to "constitutive causality," recognizing that social meanings predispose individual behaviors (Schwartz-Shea 2015, 141; also see Norman 2021; Ylikoski 2013).

Neo-Marxist overdetermination is far more skeptical about causal inference. Althusser argued that social processes should be conceived as structured, complex totalities where it is difficult to disentangle causal processes. Nonetheless, while there is scholarly debate,[2] Park (2013, 334) argues that Althusser considered complex social totalities to be determined "in the last instance" by economic forces. While Althusser's theory of overdetermination precludes that capitalism is ever able to *unilaterally* structure social phenomena, it does nonetheless acknowledge that capitalism plays a dominant role. The distinguishing feature of neo-Marxist overdetermination is thus a fusion of structural Marxist ontology with a (structuralist) epistemology.[3]

2.2.3 | Generalization

Finally, we turn to approaches to generalization, where we find important differences between the three research epistemologies observed in forest carbon offsetting in Uganda.

Under neopositivism, the standard of validity, generalization refers to "the extent to which inferences drawn from a given study's sample apply to a broader population" (Findley et al. 2021). For example, to generalize legitimately from a randomized controlled trial requires that the control group represents a reasonable counterfactual to the treatment group (Eble et al. 2016). Qualitative neopositivist research tends to be more conservative about opportunities for generalization. This does not mean generalization is impossible, but should be limited to cases that might reasonably be considered to share certain characteristics with the case(s) investigated—what Steinberg (2015) refers to as "system resonance."

In contrast, because of their attention to causal complexity and spatiotemporal specificity, interpretivists tend to be more circumspect of generalization. One reason is that interpretivists assert that social meanings are location specific—"what is being learned are the specific, local meanings"—which cannot easily be generalized beyond the immediate case at hand (Yanow 2014, 145). As Lincoln and Guba (1985, 124) claim, "[l]ocal conditions, in short, make it impossible to generalize." Nonetheless, some interpretivists offer *transferability* instead of generalization. The goal is to provide "the thick description necessary to enable [other researchers] to reach a conclusion about whether transfer [is possible]" (Lincoln and Guba 1985, 316). Transferability is often signaled by offering "lessons learned" from research, which transfer to other research teams the effort of verifying whether findings are appropriate for understanding different cases.

Neo-Marxist overdetermination might be expected not to subscribe to generalization given its emphasis on causal complexity and spatiotemporal specificity, similar to interpretivism. Nonetheless, in research conducted from this epistemological position we do observe the practice of analytic generalization. Also known as "theoretical generalization" by Mitchell (1983), analytic generalization is distinguished from neopositivist "statistical generalizations" in popular social science methods textbooks including Yin (2014) and Bryman (2012). As explained by Eisenhart (2009, 60), the point of analytic generalization

"is not to show that every site with the characteristics of a total institution produces the same results, but rather to show how each new site potentially represents different values of a generic process."[4] We submit that, in neo-Marxist overdetermination, the "generic process" of research interest is the global capitalist economy, which ultimately structures social phenomena. However, researchers subscribing to different structural epistemologies might make analytic generalizations toward other generic processes.

3 | Methodology of Critical Review

Critical review involves scrutinizing literature in a specialized area, where the selection of texts is guided by researchers' knowledge rather than formal bibliographic analysis techniques (Paré et al. 2015).

Our review draws on 31 peer-reviewed articles covering 12 forest carbon offsetting projects in Uganda. These include eight afforestation/reforestation and four REDD+ pilot projects on the voluntary carbon market (Table 2). The Appendix S1 justifies text selection and includes Table SA1, listing texts with researcher affiliations and funding sources. We included texts even for inactive projects, such as the Mt. Elgon FACE project, which ended in 2004. Due to space constraints, we do not detail individual research topics. As noted in Appendix S1, environmental justice and governance received the most attention, followed by local livelihood impacts (Table SA2). Far less research addressed climate mitigation claims like additionality (Michaelowa et al. 2019), and biodiversity conservation was the least studied.

To assess ontology, epistemology, and methodology, we inductively classified papers through close textual analysis. It is not common practice for researchers to state their ontological or epistemological positions; instead, these can be inferred from methods and result interpretations. We began by summarizing research methods as well as the analysis of how results reported are interpreted in studies. Thus, the first step of the critical review was to summarize different research methods and field data collection techniques.

To distinguish between research ontologies, we placed texts along synchronic-diachronic and structure–agency continua. Synchronic studies focus on the current situation at hand, while diachronic studies are forward-looking or historically minded. Along the structure–agency continuum, we distinguished texts inductively based on their emphasis on agency, structure–agency balancing institutions, or social structures. Important indicators were the degree of agency ascribed to policy actors observed, particularly local communities, references to institutions, as well as invocations of unobserved structural forces, such as global capitalism.

In order to distinguish between different research epistemologies, we considered whether studies focused on objective behavior and/or social meanings; the causal ontology informing the study; as well as whether and what type of generalizations were made. Neo-Marxist overdetermination was identified through the practice of making analytic generalizations toward global capitalism as a structural process.

Though not central to our interpretation, researcher affiliations and funding sources are informative (Table SA1, Table 3). Only 5 of the 31 papers were co-authored by Uganda-based researchers; most authors were affiliated with OECD institutions. Funding mainly came from academic councils and development finance institutions, with some philanthropic support; no private sector funding was noted. Finally, we used VOSviewer software to analyze bibliographic coupling (Figure 1), a method for visualizing similarities between texts based on shared references (Van Eck and Waltman 2014).

4 | Results

4.1 | Observed Research Methods

In Table 4, we identify different research methods and field data collection techniques observed across all 31 papers. Overall, the results suggest a preference for qualitative over quantitative methods. The visualization of bibliographic coupling presented in Figure 1 also indicates a quantitative–qualitative divide. On the left of the figure, we find econometric studies, while on the right are more qualitative research studies.

The majority of the studies made use of interviews and focus group discussions. These techniques were used to collect data from local actors in 24 of the studies—over two-thirds of our sample. Of these, all but two also included interviews with key informants outside the local communities involved (Fisher 2012; Nakakaawa et al. 2010). Three studies undertook interviews exclusively with external actors (Fischer and Hajdu 2018; Hajdu et al. 2016; Richards and Lyons 2016). While most of the interviews appear to be semi-structured interviews, there is some variation. For example, Cavanagh and Benjaminsen (2015, 732) refer to "unstructured interviews"; however, in Cavanagh and Benjaminsen (2014, 68), the same authors refer to semi-structured interviews, albeit with regard to the same field effort.

Only five studies rely on participant observation, most clearly in the work of Cavanagh and Benjaminsen (2015). Most authors adopting participant observation provide little detail on time spent in the field, particularly among local communities. For example, Blum (2020, 2–3) reports having "conducted participatory observation of one weekly management meeting" in addition to site visits during 3 weeks of fieldwork over a 2-month research stay in Uganda. Finally, participatory research methods appear in only two studies: Namaalwa et al. (2017) and Shames et al. (2016). No study mentioned the use of member checks to validate research interpretations of social meanings, suggested as best practice in interpretivist research (Schwartz-Shea 2015).

Only nine studies collected quantitative data through household surveys. Of these, four used data collected from household surveys to undertake experimental and quasi-experimental analysis. Three are related to a randomized controlled trial to gauge the effects of the Budongo-Bugoma Payment of Ecosystem Services (BBPES) Program in western Uganda (see Jayachandran et al. 2017 and others).

TABLE 2 | Forest carbon offsetting projects in Uganda.

No.	Project name	Project developer	Tenure arrangement	Standard	Crediting period	References
Afforestation/reforestation carbon offset projects						
1.	Mt Elgon Forests Absorbing CO2 Emissions project (FACE) Project	FACE and UWA	Degraded national park	Voluntary (Pre-CDM)	1992–2004 (Project halted in 2004)	Cavanagh and Benjaminsen (2014), Cavanagh and Benjaminsen (2015), Fisher et al. (2018)
2.	FACE Kibaale Reforestation Project	FACE and UWA	Degraded national park	CDM	1999–ongoing	Nel (2015a, 2016)
3.	Bukaleba Reforestation Project	Green resources	Degraded CFR	VCS		Lyons and Westoby (2014), Nel (2015a), Nel and Hill (2013), Richards and Lyons (2016), Schmid (2023), Westoby and Lyons (2016)
4.	Namwasa Reforestation Project	New Forests Company	Degraded CFR	CDM	2005–2025	Nel (2015b, 2016), Osewe et al. (2023)
5.	Nile Basin Reforestation Project	NFA	Degraded CFR	CDM	2007–2027	Nel (2016), Osewe et al. (2023), Peskett et al. (2011), Purdon (2015)
6.	Trees for Global Benefits (TFGB) Program	ECOTRUST	Smallholders/ customary land	Plan Vivo	2003–ongoing	Fisher (2012), Kiyingi et al. (2016), Lee et al. (2016), Nakakaawa et al. (2010), Osewe et al. (2023), Peskett et al. (2011), Purdon (2015)
7.	Kachung Forest Project	Green resources	Degraded CFR	CDM	2006–2026	Edstedt and Carton (2018), Fischer and Hajdu (2018), Lyons and Westoby (2014); Nel (2016), Richards and Lyons (2016), Shames et al. (2016); Suiseeya and Caplow (2013), Westoby and Lyons (2016)
8.	Kikonda Forest Reserve Project	Global woods	Degraded CFR	Gold standard	2002—	Blum (2020), Lee et al. (2016); Nel (2015b, 2016), Peskett et al. (2011), Suiseeya and Caplow (2013)

(Continues)

TABLE 2 | (Continued)

No.	Project name	Project developer	Tenure arrangement	Standard	Crediting period	References
REDD+ carbon offset projects						
9.	The Ongo Community Forest REDD+ Pilot Project	ECOTRUST	Degraded CFR and customary land	Plan Vivo/ REDD+ readiness		Namaalwa et al. (2017), Nel (2016), Osewe et al. (2023)
10.	Murchison-Semiiki REDD+ project	Northern Albertine Rift Conservation Group (WCS lead)	Degraded CFR and customary land	No Standard/ REDD+ readiness		Nel (2016)
11.	Mount Elgon Regional Ecosystem Conservation Project	Lake Victoria Basin Commission (UWA lead)	Degraded CFR and customary land	No Standard/ REDD+ readiness		Nel (2016)
12.	Budongo-Bugoma Payment of Ecosystem Services (BBPES) Program	Chimpanzee Sanctuary and Wildlife Conservation Trust	Smallholders/ customary land	No standard	No crediting	Jack and Jayachandran (2019), Jayachandran et al. (2018), Jayachandran et al. (2017)

Another quasi-experimental study was undertaken by Kiyingi et al. (2016) to examine the impacts of household tree planting on household poverty and food security by comparing participants in the Trees for Global Benefits (TFGB) program with smallholders planting *Eucalyptus* as well as a control group. Comparative household surveys were also used in Nakakaawa et al. (2010) and Purdon (2015). Finally, Fisher (2012) engaged community focus groups in a benefit-ranking exercise to obtain ordinal ranked quantitative data to compare with qualitative information.

Remote sensing was used in five studies. The most sophisticated was that used to determine the effects of the BBPES Program, cited above. In addition, Schmid (2023) considered whether the geography of violent and other conflicts in Africa, measured through the Armed Conflict Location and Event Dataset (ACLED), was associated with the geolocation of forest carbon offset projects under the Verified Carbon Standard (VCS) standard of the voluntary carbon market. In an example of mixed methods research, Schmid (2023) reports on household interviews in the Bukaleba community conducted by an international NGO in order to support geospatial analysis. Finally, Hajdu et al. (2016) used new Landsat imagery to investigate claims of forest degradation in Kachung Central Forest Reserve, upon which baseline conditions for the Clean Development Mechanism (CDM) project were predicated.

Two other quantitative methodologies were unique and worth describing. First was a study by Suiseeya and Caplow (2013), who extracted text from documentation submitted for accreditation under the Climate, Community and Biodiversity Alliance (CCBA) standard of the voluntary carbon market for 56 forest carbon offsetting projects—including three projects in Uganda. In particular, they focused on text where project developers describe efforts to engage with communities, which the researchers coded across 10 criteria of procedural justice. Finally, Osewe et al. (2023) conducted an online survey ($N = 16$) to assess perceptions regarding 25 payment for ecosystem services projects in East Africa among experts, forest authorities, and researchers.

Few longitudinal studies were found, with repeated measurements reported in only 11 studies. However, the average time between measurements was 2.6 years, a timeframe in which conclusive change may be difficult to observe. The longest duration was one study of the BBPES Program over the 5-year period 2011–2016 to discern effects once payments had ceased (Jayachandran et al. 2018), followed by a study by Namaalwa et al. (2017) over a 4-year period.

4.2 | Observed Research Ontologies

Turning to ontology, we observe considerable diversity in the ontological positions of the papers reviewed (Table 5). Slightly more than half might be considered as privileging structural dimensions of social theory, while approximately two-thirds were deemed synchronic. We unpack these categorizations in this section, building off of Grabs et al. (2021), though with certain adjustments.

TABLE 3 | Distribution of researcher country affiliation and funding sources.

	Academic research council	Development finance institutions	Philanthropic foundations	Not reported	Total
OECD	B2020, CA2017, CB2014, CB2015, EC2018, F2012, F2018, FH2018, H2016, JJ2019, J2017, L2016, N2010, P2015, RL2016, S2023, SC2013, WL2016	EC2018, F2018, J2017, J2018, L2016, N2010, S2016, SC2013	P2011	A2004, LW2014, NH2013	**30**
Other developing countries	O2023, WL2016	S2016		A2004, N2015a, N2015b, N2016	**7**
Uganda	BGS2000, F2018, K2016, N2017	BGS2000, F2018, S2016	BGS2000		**8**
Total	**24**	**12**	**2**	**7**	**45**

Note: Given that papers might be included in various categories, the total distribution of research country affiliations and funding source categories exceeds the 31 papers reviewed.

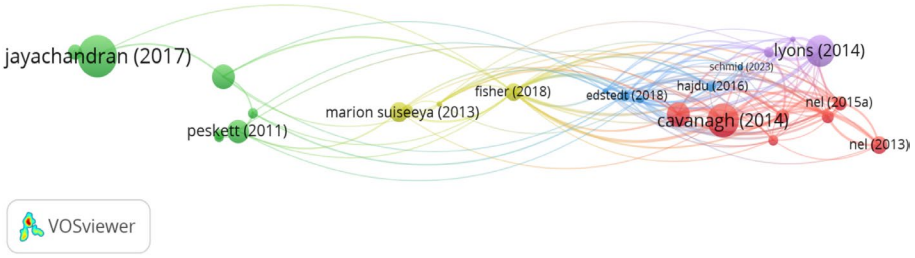

FIGURE 1 | Analysis of bibliographic coupling of 31 texts investigating forest carbon offsetting in Uganda. Visualization made with VOSviewer version 1.6.20. All texts in Table 2 were included in the analysis except for BGS2000, J2018, K2016, and N2016, which were not listed in Scopus.

4.2.1 | Agency Emphasizing

Along the structure–agency continuum, we identify 10 studies that emphasized human agency. Indicative of the synchronic/agentic category, we include seven studies that emphasize the behavior of individual households. This includes econometric studies (Jack and Jayachandran 2019; Jayachandran et al. 2018, 2017; Kiyingi et al. 2016) as well as studies focusing on biodiversity and carbon valuation of trees grown on household plots (Aune et al. 2004; Nakakaawa et al. 2010). We also include Fisher (2012), given the grounding of the case study in researching smallholder motivations for participating in the TFGB program in theories of neoclassical economics, including crowding out effects and discount rates.

Diachronic/agentic studies include Namaalwa et al. (2017) and Shames et al. (2016), both of which have relied on participatory research methods to examine the Ongo Community Forest REDD+ Pilot Project and Kachung Forest CDM Project, respectively. In both studies, research over time has allowed for temporal dimensions of projects to emerge—both opportunities and enduring challenges. However, a more skeptical view is observed in a third diachronic/agentic study by Lee et al. (2016) of the Kikonda Forest Reserve CDM project. Their results demonstrate a number of governance mismatches in terms of project timing, payments, and knowledge of carbon markets. Given the nature of these mismatches, the authors conclude that "trade-offs are inevitable" in project governance. Nonetheless, trade-offs might be addressed by "bridging organizations," defined as project developers who "mediate between actors at different scales [global to local]" (100). They conclude that bridging organizations are likely to "play a key role in agricultural carbon markets for the foreseeable future" (106).

4.2.2 | Structure–Agency Balancing

At least five papers suggest a balancing of structure and agency via institutions. Many of these are synchronic in the sense that they emphasize geographic dimensions of projects over temporal ones and invoke Elinor Ostrom's rational choice theory of common property resources. This is perhaps best observed in the study of five forest reserves by Banana and Gombya-Ssembajjwe (2000), where the authors pay considerable attention to the size of forest reserves as an explanation for variation in forest governance. Similarly, the study by Peskett et al. (2011) offers a snapshot of the "institutional structures" governing three forest carbon offsetting projects in Uganda.

A few institutional studies might be considered diachronic. The study by Suiseeya and Caplow (2013) raised questions about the capacity of co-benefits standards for forest carbon offset projects

TABLE 4 | Summary of research methods and field data collection techniques.

		Qualitative approach		Quantitative approach		
		One-shot case study	**Comparative case study**	**Descriptive**	**Experimental/ quasi-experimental**	**Total**
Field data collection	Forest sampling plots			A2004, BGS2000	N2010	**3**
	Quantitative household surveys			A2004, S2023	K2016, J2017, J2018, JJ2019, P2015	**7**
	Quantitative focus groups			F2012		**1**
	Semi-structured interviews and focus groups	B2020, CA2017, CB2014, CB2015,[a] EC2018, FH2018,[c] F2012,[b] H2016,[c] N2017	F2018, L2016, LW2014, N2010,[b] NH2013, N2015a, N2015b, N2016, P2011, P2015, RL2016,[c] WL2016		J2017, J2018, JJ2019	**24**
	Participant observation[a]	B2020, CB2015, EC2018, FH2018	F2018			**5**
	Participatory research methods	N2017	S2016			**2**
	Remote sensing			H2016, S2023	J2017, J2018, JJ2019	**5**
	Online questionnaire			O2023		**1**
	Content analysis				SC2013	**1**
	Longitudinal analysis	CB2014 (2009–2011), CB2015 (2009–2011), FH2018 (2014–2017), N2017 (2012–2016)	L2016 (2012–2015), LW2014 (2012–2013), S2016 (2012–2014), WL2016 (2012–2014)		J2017 (2011–2013), J2018 (2011–2016), JJ2019 (2011–2013), N2010 (2003–2006)	**11**
	Member checks					**0**
Total		**18**	**18**	**8**	**17**	**61**

Note: Given that papers might be included in various categories, the total distribution of research methods and field data collection categories exceeds the 31 papers reviewed.
[a]Authors refer to the use of "unstructured interviews" in CB2015, though semi-structured interviews in CB2014.
[b]Semi-structured interviews and focus groups were undertaken at only the local level.
[c]Semi-structured interviews were undertaken at the nonlocal level only, including project developers and district, national, and international actors, though FH2018 and H2016 are also informed by participant observation at the local level.

TABLE 5 | Summary of ontological diversity of research into forest carbon offsetting in Uganda.

		Structural dimension			
		Agency	**Structure–agency balancing**	**Structure**	**Total**
Temporal dimension	Synchronic	Calculated strategic behavior A2004, F2012, K2016, J2017, J2018, JJ2019, N2010	Rational choice institutionalism BGS2000, O2023, P2011	Global market power CA2017, CB2014, EC2018, LW2014, NH2013, N2015a, N2015b, N2016, RL2016, S2023, WL2016	20
	Diachronic	Learning and experimentalism N2017, L2016, S2016	Historical institutionalism P2015, SC2013	Neo-Gramscian B2020, CB2015, F2018, FH2018, H2016	11
Total		10	5	16	31

to institutionalize procedural justice in practice. However, their final conclusion is forward-looking in that "the standards play a valuable role in continuing the discussion about how to ensure that forest carbon projects do not continue to exclude forest-dependent communities and…[have] the potential to contribute to narrowing the social justice gap in global forest governance" (976). Finally, Purdon (2015) refers to the history of development policy paradigms of states in which carbon offset projects are situated in order to explain the additionality of CDM forest and bioenergy carbon offset projects across Tanzania, Uganda, and Moldova. Such ideas shape institutions and organizations involved in forest carbon offsetting.

4.2.3 | Structure Emphasizing

At the other end of the spectrum are 16 studies emphasizing structural dimensions of social theory. Most invoke global capitalism as an overarching social structure shaping both forest policy in Uganda as well as global interests in forest carbon offsetting. The exception is Schmid (2023), who does not share a commitment to global capitalism as an overarching social structure. Rather, the author suggests that the ideological prioritization of climate change mitigation might limit learning about the social impacts of projects.

Of those invoking global capitalist structure, we identify 10 as being characterized by a structural/synchronic ontology. These studies implicitly or explicitly refer to global capitalism as a structural force operating in the background, which shapes forest carbon offsetting. One of the main conclusions of Westoby and Lyons (2016, 272) is indicative: "The forms of governance that define privatized development represent structural forces which lead to ongoing enclosure of land, forced displacement, and diverse forms of violence; and as a result, people in affected communities are going hungry—with many local villagers describing challenges in securing sufficient food for themselves and their families." More explicitly, in their investigation of the TFGB project, Carton and Andersson (2017) adopt Marx's subsumption theory, which seeks to explain "how capital takes over existing production processes and social arrangements and intervenes in both for its own purposes" (Walsh 2021, 7). As we explore in our later analysis of epistemological positions, the structural Marxist ontology tends to be associated with neo-Marxist overdetermination.

However, other structural papers are more neo-Gramscian and diachronic in that, while agreeing on the saliency of global capitalism, they also point to other ideational factors that suggest opportunities for change. For example, Fischer and Hajdu (2018, 337) emphasize that project developers and international carbon credit buyers "did not deliberately ignore local livelihood concerns, but inadvertently came to disregard these." Similarly, Blum (2020, 8) notes that in contrast to other studies, their investigation of the Kikonda Forest Reserve Project found that relationships between the project developer and local communities were improving, which might be attributed in part to the local population's "power to resist." Finally, Cavanagh and Benjaminsen's (2015) investigation of the Mt. Elgon FACE Project focuses on "guerrilla agriculture" tactics whereby "farmers at Mount Elgon are frequently effective at carving out spaces of relative autonomy" (Cavanagh and Benjaminsen 2015, 741).

4.3 | Observed Research Epistemologies

We summarize our interpretation of epistemologies observed in all 31 papers in Table 6, decomposed by basic methodological approach (quantitative, qualitative, or mixed). We considered 16 of the studies to be neopositivist, 5 interpretivist, and 10 to be motivated by neo-Marxist overdetermination. All but one of the interpretivist studies used qualitative methods, while all studies practicing neo-Marxist overdetermination did so. We unpack our categorization of research into forest carbon offsetting in more detail below:

4.3.1 | Neopositivism

The majority of studies considered in this critical review, nearly half, were deemed to be neopositivist. A number of emphasis testing causal relationships and assessing generalizability. For example, here we include the experimental and quasi-experimental studies of the BBPES Program (Jack and Jayachandran 2019; Jayachandran et al. 2018, 2017). A number of quasi-experimental methods have been used to study

TABLE 6 | Summary of epistemological diversity of research into forest carbon offsetting in Uganda.

	Methodological approach			
Epistemology	**Quantitative**	**Qualitative**	**Mixed**	**Total**
Neopositivism	A2004, BGS2000, K2016, J2017, J2018, JJ2019, O2023, SC2013	B2020, L2016, P2011, S2016	F2012, N2010, P2015, S2023	16
Interpretivism		CB2015, F2018, FH2018, N2017	H2016	5
Neo-Marxist overdetermination		CA2017, CB2014, EC2018, LW2014, NH2013, N2015a, N2015b, N2016, RL2016, WL2016		10
Total	**8**	**18**	**5**	**31**

the TFGB Program, particularly comparing socioeconomic characteristics of participating and non-participating households (Kiyingi et al. 2016; Nakakaawa et al. 2010; Purdon 2015). Significantly, Purdon (2015, 468) concludes that such analysis supports the additionality claim of the TFGB program.

Generalizations are clearly made in the large-N studies reviewed. In a mixed-methods investigation of the geographic relationship between 22 forest carbon offset projects and conflict in sub-Saharan Africa, Schmid (2023, 52) concludes that results suggest "that the findings of case-by-case based research also apply to the larger picture" and concludes that "forest carbon projects seem to markedly increase community contestation in their surroundings [across sub-Saharan Africa]." More limited is the conclusion reached by Suiseeya and Caplow (2013) in their study of 56 carbon offset projects across the developing world, including Uganda. They consider the degree to which procedural justice is practiced under voluntary carbon market standards, concluding that while such standards might be "construed as standards of justice theoretically, in practice they may not be" (975).

Generalizations of much more limited scope were made in small-N comparisons. For example, in their study of the institutional arrangements governing three forest carbon offsetting projects in Uganda, Peskett et al. (2011) derived general principles for how to better involve local actors, devise project rules, and build relationships with other institutions with regard to REDD+ institutions. Such principles are similar to interpretivist transferability and the practice of generating "lessons learned." Finally, Purdon (2015) identifies a causal mechanism explaining project additionality—whether carbon credits might genuinely be viewed as representing emission reductions/sequestration—from a small-N cross-country comparison of forest and bioenergy carbon offsetting projects, including projects in Uganda. The broadest generalization among these small-N comparisons is Lee et al. (2016), where the authors investigated the special role of project developers of seven agroforestry carbon offset projects in Uganda, Tanzania, and Kenya. But even here, the scope of the inference is limited: "The success of [agroforestry] carbon markets...depend, to a large part, on the efficacy of these bridging organizations" (106).

At least two one-shot case studies might be considered neopositivist. First, Fisher (2012, 52) identifies a causal mechanism that relates carbon payments to other motivations for tree-planting and concludes that her findings have relevance for other payment for ecosystem services (PES) schemes using individual payments on private lands. Second, Blum (2020) identifies a three-part causal mechanism linking transnational narratives of carbon finance to local resistance. Local actors are first excluded from project lands through transnational narratives of "illegality and degradation." However, second, local actors resisted such exclusion which, third, compels project developers and carbon standards to react.

4.3.2 | Interpretivism

The epistemological posture that was identified the least frequently among the papers of our critical review was interpretivism. Among the more interpretivist studies is that by Fisher et al. (2018, 260) who, in their comparative analysis of the TFGB program and the, now closed (since 2004), Mt. Elgon FACE Project, seek "a fuller understanding of the reactions of local people to carbon forestry projects and the outcomes of these projects." Based on interviews and observation at local community meetings, the authors conclude that distributive justice concerns predominate in the TFGB program while inadequacies in terms of distributive, procedural, and recognition-based justice undermined the Mt. Elgon FACE Project. However, despite concerns about distributive justice regarding the TFGB program, the authors conclude that "these concerns do not appear to be significant enough to compromise legitimacy and the project's functioning is largely unaffected" (267). Avoiding generalization, they assert that their research "underscores the need to take an explicit focus on notions of justice...prior to project implementation" (267). Another comparative interpretive study is Shames et al. (2016). Relying on participatory research into forest carbon offset projects in Kenya and Uganda, the authors distil lessons for building local capacity for carbon offsetting, especially how community-based intermediaries might take on new and more complex roles.

A few papers focusing on a single-case study were also interpretivist. Perhaps the most clearly so was Fischer and Hajdu (2018), where the authors sought to understand how the problems with the Kachung Forest Project, identified in Lyons and Westoby (2014), went ignored by Norwegian and Swedish stakeholders until 2015. Drawing largely on interviews with Norwegian and Swedish stakeholders, the authors identify an

international stakeholder discourse described as a "will to improve" that "has significant impacts on how interventions are constructed and subsequently upheld, despite criticism" (329). Significantly, they conclude that the neo-Marxist explanation offered by Lyons and Westoby (2014, 337) "fails to capture a significant aspect of the case, namely that most nonlocal actors who engaged in Kachung did not deliberately ignore local livelihood concerns, but inadvertently came to disregard these."

A related paper by Hajdu et al. (2016) on the additionality claims of the forest carbon offsetting project at the Kachung CFR is also largely interpretivist. While it reflects some neopositivist characteristics by including a remote-sensing exercise, the main thrust of the article is on how "the current CDM process allowed the creation of a narrative of degradation for the Kachung area that seems unfounded, or at least severely exaggerated" (420). They attribute this to a combination of factors including the interests of the project developer, preconceived notions of African environments as well as general statistics on deforestation in Africa. Avoiding generalization, the authors use the case study to show "the extent to which interpretations can be influenced by pre-existing perceptions and expectations if these are not questioned" (421).

Some critical studies of forest carbon offset projects in Uganda also demonstrate interpretivist foundations. For example, Cavanagh and Benjaminsen (2015) aim to understand the motivations and tactics used by smallholders resisting what they perceive to be their illegitimate eviction from Mt. Elgon National Park during the Mt. Elgon FACE Project. However, they also include "a number of second-order implications" that constitute analytic generalization. For example, they conclude that "more broadly...the violence that marks emerging forms of 'green grabbing' remains largely hidden from the international public sphere" (63). To be conservative in our analysis, we retain this publication in the interpretivist category.

Other interpretivist papers include a 4-year study by Namaalwa et al. (2017). The authors describe both a number of "processes that have unfolded during the design and implementation" of the REDD+ project investigated but also presents a number of "Lessons Learned for Sub-National REDD+ Architecture" (325). As suggested earlier, emphasis on "lessons learned" instead of generalizations might be considered an indicator of interpretivist research.

4.3.3 | Neo-Marxist Overdetermination

While a number of authors exclusively use qualitative methods, they do not conform to interpretivism by focusing on social meanings; nor, to the extent that they focus on objective behavior, do they restrain their conclusions to limited generalizations. Rather, they seek to use research findings to make much broader arguments about what is perceived to be the effects of global capitalism and neoliberal economic policy on Uganda's forest sector and local communities. We submit that this exemplifies neo-Marxist overdetermination, which constituted almost one-third of the studies included in our critical review. Importantly, all studies that we identify as representative of neo-Marxist overdetermination are also associated with a structural/synchronic ontology, as reported above.

A first example is the investigation of forest carbon offset projects at Bukaleba and Kachung CFRs by Lyons and Westoby (2014). The authors conclude that adverse livelihood outcomes "represent a neoliberal (state-enabled) land grab, with outcomes that amount to carbon colonialism" (20). They also make clear generalizations: "Given Green Resources' scale of operations...our findings are significant. The new forms of carbon colonialism being driven by displacement and constrained resource access can be expected to be occurring elsewhere, both under the mandate of licenses issued to this company, and other plantation forestry operators" (20). Analytical generalization is also evidenced in research into forest carbon projects at Bukaleba CFR and Mt. Elgon National Park by Nel and Hill (2013). Importantly, they find the latter project to have delivered community benefits, even going so far as to describe it as "a progressive space of neoliberalism" (436). Yet the study does not seek to explain different outcomes between projects; rather, it emphasizes that both projects should be seen as manifestations of a generic process associated with neoliberalism: "an attempt to secure the internal territorialization of the State" (432).

This emphasis on analytical generalization is evidenced in other studies. Nel (2015a, 2309) concludes that forest governance in Uganda "is changing...from the exclusive control of territories to a hybrid governance with leanings toward control through flows of both carbon credits and biomass." Similarly, the main conclusion of Nel (2016) is that carbon forestry interventions in Uganda "seem to be falling short in their equity commitment. This appears to have as much to do with the social condition of forestry in Uganda as it has with the faltering neoliberal environmentality that characterize the projects." Indeed, the author explains that "while generalizations with regard to the "state of carbon forestry" are challenging—as with much qualitative research (Bryman 2012)—they are well worth pursuing for the insights they provide" (Nel 2016, 2). As indicated earlier, the textbook of Bryman (2012) promotes analytic generalization.

A number of single case studies also demonstrate analytic generalization toward global capitalism. For example, Carton and Andersson (2017) argue that challenges facing the TFGB project exemplify Marx's theory of subsumption as it extends to nature. Drawing on interviews with local smallholders, the authors suggest that capitalists at the global level (global firms pursuing low-cost carbon credits) influence the behavior of the project developer, which in turn subsumes individual smallholders through a range of disciplinary techniques, including carbon offset project training as well as monitoring campaigns. The broader analytic generalization is that "the management practices of carbon forestry are fundamentally shaped by the requirements of the carbon market, which for all sorts of socio-economic reasons (not least widespread poverty) are often far from the reality on the ground" (12).

A final example of the global capitalist structure underpinning neo-Marxist application of analytic generalization comes from a study by Edstedt and Carton (2018) of a project at Kachung Central Forest Reserve. The authors conclude that the project developer is pursuing a project with "benefits that (only) capital can see" which "by design degrades local ecologies and therefore at least in part stands in conflict with the needs and priorities of the communities who are dependent on them" (321). This informs a

broader theoretical conclusion that, "While some forestry projects evidently have more local benefits than others, the fundamental contradiction between commodification and the pursuit of broader sustainability objectives seems hard to resolve" (322).

5 | Discussion

The purpose of this critical review has been to map the diversity of ontologies and epistemologies used in empirical research into forest carbon offsetting to better understand whether knowledge in this area of environmental governance is cumulating, fragmenting, or diversifying. We have focused on forest carbon offsetting in Uganda, which hosts a relatively large number of such projects in sub-Saharan Africa.

Our most important finding is that the extent and character of the ontological and epistemological differences are significant, which challenges traditional understandings of knowledge cumulation. This is not to say that methodological differences are unimportant. Visualization of the bibliographic coupling of texts reviewed suggests a qualitative-quantitative divide. But probing deeper reveals different ontological and epistemological positions underwriting *similar* qualitative methods—particularly semi-structured interviews and case studies. Such qualitative methods lend themselves to neopositivist, interpretivist, and neo-Marxist epistemologies. Too often, however, qualitative and quantitative methods remain incorrectly associated with interpretivist and neopositivist epistemologies, respectively (Lawler and Waldner 2023).

Such findings help understand methodological critiques of some of the studies comprising our critical review. For example, Fischer et al. (2016), whose research we associate with interpretivism, question the case-study selection in Lyons and Westoby (2014), whose research we associate with neo-Marxist overdetermination. The former authors argue that the latter "combined findings from two different plantations...in order to paint a more negative picture of the overall situation than is actually the case" (267). Similarly, Purdon (2018), whose research is associated with neopositivism, suggests that assumptions of structural Marxism underpinning Carton and Andersson (2017, 1), "may predispose [the authors] to see any economic relationship between global capital, labor, and nature as inherently conflict ridden and exploitative and to neglect actual benefits." Such methodological critiques may be indicative of more fundamental differences in research ontology and epistemology. Indeed, there is a tension between research methodology and the ontological and epistemological presuppositions associated with neo-Marxist overdetermination. Namely, interpretation of empirical findings is presupposed in accordance with the structural ontology of neo-Marxism and need not necessarily be drawn from methodological observation. While beyond the scope of our study, empirical research influenced by neo-Marxist overdetermination may be reintroducing verificationism—which seeks to confirm theory through observation—into social science, which contrasts strongly with neopositivist falsification as introduced by Karl Popper.[5]

We also demonstrate that structural ontologies and critical epistemologies such as neo-Marxist overdetermination are far from marginalized among the studies comprising our critical review. While half of the studies were neopositivist, nearly one-third were identified as neo-Marxist overdetermination, with interpretivism being the most infrequent. Significantly, all research conducted from the point of view of neo-Marxist overdetermination was associated with a structural/synchronic ontology, while almost all interpretivist research was associated with a structural/diachronic ontology. Furthermore, structural ontologies were significantly more frequently identified in our critical review than agentic ontologies, while structure–agency balancing ontologies were the least represented. Such findings might be surprising, as critical neo-Marxist ontological and epistemological approaches are often assumed to be marginalized in environmental governance research.

While our critical review suggests that traditional understandings of how knowledge cumulation is not reflected in research into forest carbon offsetting in Uganda, it is difficult to determine if the range of ontological and epistemological positioning represents an improvement in terms of epistemic diversity or rather whether it indicates increasing fragmentation. There are a few reasons for this. First, differences in fundamental ontological and epistemological presuppositions might be considered to represent a "fragmented adhocracy" that explains the polarized debate on forest carbon offsetting. Indeed, the fusion of structural/synchronic ontology and epistemology of neo-Marxist overdetermination appears considerably different from neopositivism and interpretivism. Knowledge cumulation may require agreement on basic ontological and epistemological principles.

However, second, we are concerned that the traditional concept of knowledge cumulation itself tends to be based on neopositivist criteria of replicability and falsifiability (see Newig et al. 2023), which may diminish the contributions of interpretivism, neo-Marxist overdetermination, and other "post-positivist" research epistemologies. In this vein, awareness of ontological and epistemological differences might help researchers identify areas of disagreement and agreement from which opportunities for dialogue may emerge. Recognition of such "epistemic diversity" might allow for more nuanced research questions to be identified and innovative methodologies developed. For example, conducting neopositivist research in order to test the structural/synchronic ontology anticipated in neo-Marxist overdetermination. Relatedly, the ontological and epistemological categories informing our critical review might be contested, for example, as themselves too neopositivist (Kennedy and Fiss 2013). We welcome future research that challenges our categorization or develops new approaches to critical review.

Similar mapping exercises in other areas of environmental policy and governance might be necessary to compare with the extent and character of the ontological and epistemological differences observed in our critical review of research into forest carbon offsetting in Uganda. While we hesitate to generalize from our critical review, existing research suggests that the differences we observe are perhaps normal in such controversial areas of environmental governance. For example, Grabs et al. (2021) demonstrate that research into private environmental governance spans across all six ontological categories considered in this study. Similarly, Leipold et al. (2023) identify three different narratives underpinning existing research into the circular economy—optimist, reformist, and skeptical narratives. While the relationship between narratives and research ontologies

and epistemologies requires more sophisticated treatment than we are able to conduct in this paper, we note that studies most skeptical of forest carbon offsetting in our critical review tend to subscribe to a structural/synchronic ontology and epistemology that we have characterized as neo-Marxist overdetermination.

Reflecting on our findings, one way forward in the debate about knowledge cumulation in controversial areas of environmental governance might be to place greater emphasis on *epistemic justice*, rather than epistemic fragmentation or diversity (Frank 2013; Kotzee 2017). Epistemic justice compels us not to accept epistemic diversity as a "good in itself." In other words, the range of ontological and epistemological differences characterizing research into forest carbon offsetting in Uganda is not evidence in itself of epistemic justice. Rather, epistemic justice compels us to "remain aware of the influence of power on who is heard and must take due cognizance of the perspective of those without power" (Kotzee 2017, 330). In this light, it is worth noting that studies reported in our critical review are overwhelmingly conducted by researchers from outside Uganda, and largely from the Global North. Only 5 of the 31 papers (16%) reviewed were co-authored by researchers with an institutional affiliation in Uganda. Addressing this geographic imbalance would be an important step for promoting epistemic justice.

6 | Conclusion

Mapping the extent and character of different research ontologies and epistemologies is a useful first step toward understanding whether knowledge is cumulating, fragmenting, or diversifying with regard to polarizing topics like forest carbon offsetting in developing countries. Our critical review suggests that differences in these fundamental presuppositions can be significant, challenging traditional views of scientific knowledge cumulation. While recognizing the limits of our critical review into forest carbon offsetting in Uganda, knowledge cumulation appears to be hindered by a lack of agreement on fundamental ontological and epistemological presuppositions. Among our key findings is that research into forest carbon offsetting in Uganda is predominated by neo-positivist epistemologies (approximately half) and neo-Marxist overdetermination (approximately one-third). Structural ontologies were significantly more frequently identified in our critical review than agentic ontologies, while structure–agency balancing ontologies were the least represented. Notably, research most critical of forest carbon offsetting was characterized by an epistemology of neo-Marxist overdetermination and structural/synchronic ontology. Given the polarized debate, identifying these foundational differences may help foster dialogue between research traditions. However, epistemic fragmentation or diversity alone does not ensure epistemic justice, which requires further attention to broader power imbalances involved in the conduct of environmental governance research in developing countries.

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Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The data that support the findings of this study are available in Supporting Information S1 of this article.

Endnotes

[1] The relationship between postmodernism and neo-Marxism is complex and full examination beyond the scope of this paper (Balibar 1992; Behrent 2009; Bidet 2016; Garlitz and Zompetti 2023; Kelly 2014; Maher 2022).

[2] Park (2013) contrasts Althusserian overdetermination to Resnick–Wolff overdetermination, the latter which can be summarized as arguing that "Everything in the world participates in overdetermining everything else and is itself overdetermined by everything else" (Wolff and Resnick 2012, 44). Park (2013) points out that this invites a form of relativism that strays from Althusser's original intent.

[3] Neo-Marxist scholars argue that the unappreciated ontologies of researchers adhering to positivist epistemologies also shapes their research (e.g., see Wolff and Resnick 2012, 43).

[4] As an example, Eisenhart (2009, 61) draws on research demonstrating that prison cultures differ significantly between men's and women's prisons. This leads to the analytic generalization that "prisoners develop a culture that solves the problems created by the deprivations of prison life" though "women are deprived of different things [than men]." The generic process in this example is the deprivations of prison life, which manifests in different ways.

[5] Popper (2014 [1963]) and Popper (2012) [1945] explicitly criticized Marxism for what he ascertained was verificationism. Popper's falsification criterion continues to be discussed in the literature (see Adler 2004; King et al. 1994; Mitra 2020; Notturno 2000) while neo-Marxists have also responded to his critique (Omaboe and Usifoh 2021; Smulewicz-Zucker 2017; Verikukis 2007).

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Supporting Information

Additional supporting information can be found online in the Supporting Information section. **Data S1:** Supporting Information.