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The political life of mitigation: from carbon accounting to agrarian counter-accounts

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ABSTRACT

This article seeks to stimulate analysis of how accounting knowledge, techniques, and practices work to incorporate agriculture and land use into climate mitigation. Accounting plays a significant role in the ways that capitalism inserts itself into, reworks, or reorganises agrarian webs of life. To study these processes, we train our critical gaze on accounting itself – its epistemic foundations, instruments, and narratives, and their implications for agrarian livelihoods and relations. Through the notion of “agrarian counter-accounts,” we conclude by considering the potential of alternative methodologies and understandings of account-giving, taking, and holding in struggles for agrarian climate justice.

KEYWORDS

Climate change; accounting; climate mitigation; carbon; agrarian relations; climate justice; counter-accounts

In recent years, agricultural land, practices, and livelihoods have increasingly captured the attention of climate science, policy, and finance. On the one hand, agriculture is estimated to account for 22% of global greenhouse gas emissions, with projections rising over the coming decades (IPCC 2022a). On the other, it has been seen to hold the possibility of making a significant contribution to climate mitigation (IPCC 2019). Once on the margins of climate mitigation, agriculture along with other forms of land use are now seen to harbor vast ‘untapped potential’ in the area of reducing emissions as well as in carbon storage and sequestration, often under the banner of ‘nature-based solutions’ or ‘natural capital’ approaches (FAO 2022; Iseman and Miralles-Wilhelm 2021). Such enchantment with agriculture has seen photosynthesis framed as a ‘low-cost negative emissions technology,’ while companies and countries seeking to meet voluntary or compliance commitments to reduce emissions look to agriculture and land use as areas where emissions reductions may be readily achieved in what is often described as a ‘cost-effective’ manner.¹ The dual position of agriculture and land use as both a source of, and sink for, greenhouse gas emissions also means that it has been identified as key to achieving climate neutrality and net zero targets, terms themselves that demand critical

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¹See, for example, the Natural Climate Solutions Alliance, convened by the World Business Council for Sustainable Development and World Economic Forum. <https://www.wbcsd.org/Programs/Climate-and-Energy/Climate/Natural-Climate-Solutions/The-Natural-Climate-Solutions-Alliance>. Accessed 18 November 2022.

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interrogation (Stabinsky 2021) as they become a frame and focal point for climate mitigation ambitions for entities that range from the European Union to BP, Shell, and Nestlé.

This article sets out a research agenda to stimulate analysis of the ways that accounting knowledge, techniques and practices play a formative role in incorporating agriculture and land use into climate mitigation narratives, strategies, and interventions.² In facilitating such processes of incorporation, accounting helps to constitute more broadly the way that the problem of climate change is apprehended and, as a consequence, the ways that responses to it are envisioned, designed, and enacted. In taking up questions posed by Borrás et al. (2022, 17) – ‘What combinations of narratives and strategies frame climate change and the institutionalized responses to it in agrarian settings? What exclusions and inclusions result from this?’ – we probe one of the crucial yet often overlooked features of many contemporary responses: their reliance on epistemologies, narratives, and practices of accounting.

A key point of departure for us is that grappling with climate change and its mitigation within agrarian settings requires developing critical and analytical approaches for engaging with accounting, whose specific power and impact on agriculture and agrarian modes of production and ways of life remains under-examined. With Borrás et al. (2022, 5), we concur that ‘climate change needs to be seen in its wider, historical context, and not just as a technical phenomenon emerging from anthropogenic greenhouse gas emissions.’ Building on this, we argue that not only climate change, but ways of perceiving, understanding, and responding to it must also be historicized. The forms of knowledge and practice that constitute dominant approaches to climate mitigation cannot be separated from the framing and understanding of the problem of climate change itself.

In this article we develop a framework for engaging critically with the way that accounting comes to shape and condition climate mitigation in agrarian settings. Our work draws on on-going research conducted since 2020, using methods that include document analysis, participation in online training courses on environmental and carbon accounting, and ethnographic fieldwork in Argentina, Colombia, and western Canada. In this article and our larger work we approach accounting as a world- or environment-making phenomenon (Tsing 2015; Moore 2015). By this, we mean that in seeking to make visible particular social and ecological phenomena, accounting invariably transforms those environmental and agrarian relations that are the objects of its knowledge and interventions. Accounting is not, therefore, purely a means of measurement and calculation; it is also a novel way of reconfiguring these relations by disembedding greenhouse gas emissions from the socio-environmental conditions in which they are produced, and rendering them quantifiable units of carbon dioxide equivalent (CO₂e). In this way, it works to draw human and nonhuman life and relations, as they are constituted within agrarian worlds and practices, into emergent capitalist networks and technologies of climate mitigation. This reconfiguration, moreover, follows a specific path, as biological and ecological processes in agricultural settings are harnessed in new ways to achieve climate mitigation without halting abiding historical processes of accumulation. Accounting knowledge and practice contributes crucially to the work of opening up new spaces for accumulation in agrarian settings through the production

²Shaila Seshia Galvin and Diego Silva Garzón are the joint co-authors of this article.

of data, and the regulation and management of land, human labor, and nonhuman life. This, we show, has profound implications for the scales and modes of agricultural production that are likely to be supported by mitigation interventions, as well as for farmers' productive autonomy. As others map some of the manifestations of these new accumulation pathways (Matthan 2022; Schwartzman 2022; Stock 2022), we train our critical gaze on accounting itself – its epistemic foundations, instruments, and narratives, and their implications for agrarian livelihoods and relations.

Climate mitigation, accounting, and critical agrarian studies

The prominence of agriculture within global climate negotiations grew substantially after 2015, with the adoption of the Paris Agreement. As the first legally binding global agreement on climate change, it committed its signatories to implement Nationally Determined Contributions in an effort to limit global temperature rise to less than a two degrees Celsius increase (and ideally 1.5 degrees) from pre-industrial levels (UNFCCC 2015). With the agreement, agriculture came to occupy a more central place in climate discourse and strategy, both nationally and internationally. Notably, 148 countries included agriculture in their mitigation targets and/or actions submitted with their NDCs (Strohmaier et al. 2016). The subsequent year, at COP22 in Marrakech where signatories committed to the implementation of their NDCs, agriculture emerged as a 'critical site for the adaptation to and mitigation of climate change' (Newell and Taylor 2018). More recently, since the publication of the IPCC special reports on 1.5 degrees and on land, focus on agriculture has intensified with reductions in agricultural emissions deemed necessary to meet targets and deadlines (Leahy, Clark, and Reisinger 2020; IPCC 2018; IPCC 2019). Here, agriculture is framed as a 'sector' or 'set of activities,' necessarily reflecting the way that climate change more broadly is understood as a 'biophysical problem predominantly driven by carbon emissions' (Nightingale et al. 2020, 346). As agriculture draws more attention and investment, it is accounting that offers a discursive and technical framework that casts the agrarian as a biophysical domain within the contemporary science and policy of mitigation, bracketing agricultural emissions off from their social, historical, political, and economic moorings.³

Such a feat is not easily achieved. The emission of greenhouse gases, notably methane and nitrous oxide as well as carbon dioxide, accompany agricultural production through processes such as enteric fermentation in ruminant animals, the deposition of synthetic fertilizers or livestock manures on fields and pastures, or the microbial activity associated with soil respiration as well as flooded rice cultivation (IPCC 2006). Agrarian settings have been particularly resistant to climate mitigation initiatives and their associated accounting frameworks, at least in part because of the difficulty of measuring or estimating emissions that are multiple, diffuse, and variable. And because agricultural greenhouse gases (GHGs) emerge in different sites and through biological processes across vast areas above and below ground, the production of accurate, region-specific emissions data is more complex than in many other spheres of activity.

³A good example of this is a now widely reproduced image of agricultural sources and sinks for greenhouse gas emissions, which first appeared as 'Figure 1.1 The main greenhouse gas emission sources/removals and processes in managed ecosystems' in Volume 4 on Agriculture, Forestry, and Other Land Use as part of the IPCC's 2006 Guidelines for National Greenhouse Gas Inventories. See: (IPCC 2006).

Rethinking how greenhouse gases are understood and analyzed in relation to agriculture is important for developing an agrarian political economy attuned to the ways that pathways of accumulation are enabled by climate mitigation and to the role that accounting frameworks play in establishing these pathways. Unraveling these connections often necessitates treating carbon dioxide and other greenhouse gases as more than chemical compounds, instead probing them as both ‘substance and relation’ (Dalsgaard 2014). As a relation, a number of scholars have observed how almost every form of human activity along with the foundations of capitalism as well as social and economic life more generally are implicated in the generation of greenhouse gases. In the twenty first century, carbon has become a ‘common denominator for thinking about social life in relation to the environment’ (Bridge 2011, 821), though this common denominator is also uncommoned by uneven histories of oppression and dispossession that are linked to imperialism and colonialization, ongoing processes of settler colonialism, race, and gender inequality (Yusoff 2021; Davis and Todd 2017).

Pushing back against a narrow conceptualization of agriculture as a sector, source, and sink in relation to the generation of greenhouse gases, Reisman and Fairbairn (2021, 688) observe that agriculture is ‘not a set of impacts to be avoided but rather a site of political and economic processes to be accounted for and reimagined.’ By enabling analytical purchase on political economic processes underpinning climate change and responses to it, critical agrarian studies has, to date, engaged with climate mitigation from a range of perspectives, including green grabbing (Fairhead, Leach, and Scoones 2012), Reducing Emissions from Deforestation and Forest Degradation or REDD+ (McElwee 2016), climate smart agriculture (Newell and Taylor 2018; Clapp, Newell, and Brent 2018) and carbon offsetting (Cavanagh and Benjaminsen 2014). These studies pose a direct challenge to the way that climate science and policy decouple the problem of climate change from the political, economic, and bio-historical circumstances in which it emerged (see Chakrabarty 2009; Mitchell 2011). In particular, they highlight the tendency of such responses to ‘render technical’ (Li 2007) the problem of climate change as well as the means of tackling it. Thus, for example, framing climate change in a narrowly scientific sense as simply a ‘problem of emissions’ has enabled the proliferation of techno-fixes, such as carbon capture and storage which are increasingly recognized as necessary to achieve reductions needed to keep warming within 1.5 or 2 degrees. This elides the ways that climate change is fundamentally embedded within economic systems, activities, and practices, while intensifying asymmetries of power and inequality, opening new avenues of dispossession as well as capitalist accumulation (Clapp, Newell, and Brent 2018; Nightingale et al. 2020; Stock and Birkenholtz 2021). Climate change increasingly represents an opportunity rather than a crisis for capitalism, as climate mitigation becomes an arena of investment and industry through which capitalism finds and establishes new sites and modes of accumulation in rural worlds.

Accounting knowledge and practices, we contend, play a critical role in enabling such novel forms of accumulation because of the ways that they figure in capitalist processes, inserting themselves into, reworking, and reorganizing what Jason Moore (2015, 2017) has described as ‘webs of life.’ By making visible, quantifiable, and manageable the work of trees, plants and soils in storing or sequestering carbon emissions, accounting helps to incorporate agrarian activities into mitigation efforts. It also opens new avenues for transforming the work/energy of the biosphere into capital by internalizing previously untapped

forms of more-than-human work in the service of creating or extending networks of capital accumulation. While this is also achieved by mitigation initiatives in other sectors, such as REDD+, in agrarian settings modes of accounting, and notably carbon accounting, help to embed mitigation within productive activities, responding to the historical need of capitalism to mitigate GHG emissions without halting economic growth.

Yet despite its importance, accounting has received little attention in critical agrarian studies, as attention has frequently been drawn to particular sites (on land, in forests) and the structural processes with which they are associated. Such relatively scant attention to accounting is at least partially attributable to the difficulties posed by the complexity and dynamism of socionatural agrarian environments, where the elements that make up greenhouse gases assume different forms and undergo multiple transformations prior to their production as GHG emissions. But to overlook carbon accounting in agriculture, we suggest, is to neglect an important mechanism through which novel processes of accumulation are beginning to take shape as climate mitigation is enacted in agrarian settings. In what follows, we attune ourselves to accounting as an epistemic and ontological force that animates approaches to mitigation in agriculture.

Climate responses and accounting epistemologies

Contemporary methods of accounting for agriculture's emissions, or its capacities for storage and sequestration, extend a long history of calculative practices such as double-entry book-keeping (Mills 1994) and techniques of legibility, that have been critical in creating the conditions of possibility for capital accumulation and state power (Scott 1998). Historians of science and economics have documented how accounting practices have become authoritative forms of knowledge, melding the form that management and government assume across various domains of life (Porter 1994). Accounting is therefore 'intrinsic to and constitutive of social relations, rather than secondary and derivative' (Miller 2001, 392). More than a form of knowledge, it is replete with tools and instruments that enable concrete interventions in the world (Loft 2021; Fleischman, Funnell, and Walker 2013) and that intertwine modes of measurement with practices of government and accumulation. Processes of appropriation and accumulation, Jason Moore has pointed out, do not only take place through primitive accumulation, expanded reproduction, or accumulation by dispossession, but are importantly enabled in spaces 'in between,' particularly through 'those practices committed to locating, quantifying and rationalizing human and extra-human natures.' (Moore 2018, 249) Accounting, in this respect, enables the government and management of particular ecologies, notably in the service of shaping socio-environmental relations into productive forces that work in the service of capitalism within agriculture.

Accounting practices are deeply embedded in both climate science and policy (Bebbington, Larrinaga, and Thomson 2021; Charnock, Brander, and Thomas 2021; Newell, Boykoff, and Boyd 2012), and they lie at the core of many responses to climate change across a wide range of contexts and scales that extend well beyond agriculture – from the national inventories of greenhouse gas emissions and removals binding signatories to the UNFCCC to personal carbon footprint calculators (Dalsgaard 2014). The ubiquity of accounting epistemologies in mitigation approaches and practices builds on the emergence of much broader subfields of social and environmental accounting over the course

of the twentieth century. Though critical scholarship now links accounting with mainstream, neoliberal responses to climate change, of note is that in their early days both social and environmental accounting were subfields which claimed a certain counter-hegemonic position vis-à-vis the wider field in which they were located. While social accounting challenged mainstream financial accounting's claims of being objective and value-free, environmental accounting arose out of the recognition that as capital advances, it destroys its biophysical conditions of reproduction (Gray 1990).

Over time, however, environmental accounting has grown into a field of accounting practice that extends, rather than challenges, traditional accounting principles and frameworks by incorporating elements of nature and the natural environment that have long been considered external to society (Lohmann 2009; Hopwood 2009; Moore 2017). Managerial aspects of traditional accounting are evident in the way that environmental accounting has been applied to the internal management of corporate environmental behavior (Kumarasiri and Jubb 2016; Olsthoorn et al. 2001; Tyteca 1996) or external environmental reporting (Pattberg 2017; Hahn, Reimsbach, and Schiemann 2015; Figge et al. 2002) and, with regard to climate change, internal carbon management accounting and external carbon disclosure at the level of organizations, products and supply chains (Stechemesser and Guenther 2012). As environmental considerations became more mainstream in the corporate world under the banner of sustainability and, more recently, Environmental Social and Governance (ESG) criteria, environmental accounting has lost its once counter-hegemonic status as it becomes incorporated into management, communications, and marketing (Spence, Husillos, and Correa-Ruiz 2010).

While climate change helped to spur the development of carbon accounting as an offshoot of environmental accounting, international discussions were fostering debates on a related global concern – conservation through the valuation of biodiversity. From 2001 to 2005, the work of more than 1360 scientists resulted in the Millennium Ecosystem Assessment (MEA), a scientific appraisal of the 'conditions and trends in the world's ecosystems and the services they provide' (Millennium Ecosystem Assessment 2022). In addition, a ministerial gathering of environment ministers from the G8+6 countries in 2008, resulted in an initiative called The Economics of Ecosystems and Biodiversity (TEEB), which sought to redress the 'invisibility of nature' by recognizing and capturing the value of biodiversity and ecosystem services for business and society (TEEB 2022). Both MEA and TEEB renewed the significance of natural capital approaches – a concept first deployed in the late 1970s to highlight the role of natural resources in the production of economic value (Schumacher 1979) and later mobilized to bridge the world of ecology and accounting (Gray 1990; Rubenstein 1992) – to inform understandings of sustainability among policy makers and the business community (Groot and Braat 2015, 233). By 2013, natural capital approaches had become so popular that a Guardian article stated 'If you are looking for the next big thing in sustainability, you needn't look much further than natural capital accounting' (McGill 2013).

Carbon and natural capital accounting have facilitated the commodification of ecosystem processes, promoting a vision of 'nature' as something that can be valued in monetary terms and substituted for other forms of capital (Gómez-Baggethun and Martin Lopez 2015). The expansion of accounting principles and frameworks into environmental domains is thus a critical force underlying the economization of the environment (Sullivan 2013). The influence of accounting practices is evident, for instance, in the rise of payments

for ecosystem services, and in emissions trading systems, which are mediated by international and industry specific accounting frameworks and methodologies such as the IPCC Guidelines, the UN's System of Environmental Economic Accounting (SEEA), the Greenhouse Gas Protocol administered by the World Resources Institute and World Business Council for Sustainable Development, and the Verified Carbon Standard among many others. These accounting frameworks and methodologies have a bearing on agrarian worlds, where carbon accounting and natural capital accounting are applied. For example, based on life cycle assessment methodologies, the Greenhouse Gas Protocol, often referred to as the gold-standard for calculating and reporting GHG emissions (Ratnatunga, Jones, and Balachandran 2011), includes specific guidelines for the agricultural sector (WRI and WBCSD 2014). These guidelines are primarily intended for large producers and companies, such as fruit and crop growers, ranchers and biofuel producers, who want to develop inventories about their greenhouse emissions (WRI and WBCSD 2014, 9), but they can also be used by governmental and non-governmental initiatives.

While environmental accounting has aimed at internalizing the environmental costs of capitalist production, it has also helped to deploy rationalizing techniques to render the environment amenable to ongoing processes of capital accumulation. Although some have argued that climate change presents a crucial challenge for capitalism, it is increasingly the case that the development and deployment of environmental, carbon, and natural capital accounting in ever-widening spheres of society, economy, and daily life helps to create new domains of capital accumulation by finding novel ways of making socio-natural and ecological systems work for capital. Crucially, accounting enables greenhouse gases associated with agricultural practices and activities to be disembedded from the socioecological, historical, and political economic conditions in which they are generated. This disembedding renders them objects of measurement, estimation, and calculation that can be re-embedded in commodity and market relations amenable to appropriation and exploitation. Accounting epistemologies, therefore, provide an important foundation and condition from which new accumulation pathways can develop. But, first, the ontological and epistemological positioning of climate change as a technical and economic problem must be discursively amplified.

Amplifying accounting, dis-/re-embedding carbon: instruments and narratives

Accounting is a field of technical and professional knowledge, but it is also one where particular vocabularies, concepts, and metaphors work as epistemic objects to coproduce 'climate change as an issue of political and scientific concern' (Jasanoff 2010; Knorr-Cetina 1999; Lahn 2021, 4). The linguistic field of climate science and policy yields plentiful possibilities in this regard, and it is instructive to ask how accounting informs climate change vernaculars and with what political effects. Here, we focus on three concepts – budgets, balance sheets, and debt – which have acquired particular contemporary salience for the way in which they have amplified accounting as a means of apprehending and responding to climate change.⁴ In different ways, the language of budgets, balance

⁴Other accounting terms, such as 'stock' and 'flow,' as well as interest and dividend, also warrant attention but are beyond what we can consider here.

sheets, and debt, and their associated practices, have worked to make the immense complexities of climate change graspable and manageable within existing architectures of management and governance where accounting logics are deeply entrenched. In some instances, they have also generated opportunities for counter-mobilizations and political resistance in struggles for climate justice through the 'lenses of inequality and injustice' (Borras Jr. et al. 2022, 12; Sultana 2022; Tuana 2019; Borras and Franco 2018).

Together with calculative devices that seek to render greenhouse gas emissions quantifiable, and capable of being inventoried and commensurated, this trinity of concepts are among those that participate in the process of disembedding carbon from situated social and ecological agrarian settings and establishing conditions for them to be re-embedded in novel financial and market relations in ways that can facilitate accumulation. One of the starkest ways in which this occurs is through the enunciation of calculative devices that have been developed to make different greenhouse gases commensurable, or equivalent to one another. Commensuration, or 'the comparison of different entities according to a common metric' (Espeland and Stevens 1998, 313), has been identified as a key premise for the commodification of carbon and the constitution of carbon markets. Within scholarship on carbon accounting, several studies explore how different greenhouse gases are 'made the same,' that is, made commensurable through metrics such as carbon dioxide equivalent (CO₂e) and greenhouse warming potential (GWP). A prime example of this is 'Global Warming Potential,' an index which renders different greenhouse gases comparable to (and exchangeable with) carbon dioxide and is used in the calculation of CO₂ equivalents (MacKenzie 2009; Whittington 2016). MacKenzie (2009, 447) goes so far as to liken metrics such as Global Warming Potential and CO₂e to 'exchange rates' which enable fungibility and liquidity in carbon markets by allowing units of CO₂e to be isolated and exchanged across jurisdictions. Instruments such as CO₂e and Global Warming Potential amplify accounting, allowing greenhouse gases to be disembedded from the immediate conditions in which they are produced and repurposed to enable novel forms of accumulation within market relations.

But the mathematical relation brought forth through techno-scientific devices that render greenhouse gases commensurable or fungible neglects the multiple other relational dimensions of these gases. Illustrating this are the comments of the Director of the Colombian branch of the Dutch NGO Tropenbos, dedicated to the conservation of rainforests, who qualified the ways in which equivalence has had the effect of 'making things the same.' (MacKenzie 2009) To the contrary, this director told us, 'not all carbon emissions are made equal.'⁵ He went on to explain that a mitigation project promoting the conservation of a biodiverse rainforest is very different from a mitigation project based on reforestation through commercial plantations. While both projects might contribute to removing atmospheric CO₂, the role of a biodiverse rainforest in regulating the climate cannot be reduce to units of CO₂ emitted in a particular period of time.

Devices such as Global Warming Potential and CO₂ equivalent are powerful tools that disembed greenhouse gases from the agrarian relations through which they are produced, but they need to be accompanied by narratives that scale up and extend the

⁵Despite the ways in which they are rendered commensurable, greenhouse gases also harbor different legal, political, and chemical meanings a point that Gökçe Günel (2016) has usefully developed. Such multiplicity is just as important as commensuration for processes of commodification (Günel 2016) and, we would argue more broadly, for accumulation.

reach of accounting logics in mitigation action and finance. It is here that vernacular notions of budgets, balance sheets, and debt have enabled carbon dioxide and its equivalents to be conceptualized as a resource amenable to management and regulation, with the potential to be harnessed in accumulation processes. Such discursive transformations warrant scrutiny, while also calling for attention to be paid to the ways that agrarian relations come to be reconfigured around carbon.

One of the most fundamental ways in which narratives work is to condition the way that the problem of climate change is itself understood. In this, one of the most pervasive accounting metaphors to be taken up in climate science and policy is that of the carbon budget. The notion of the carbon budget, which posits carbon dioxide as a planetary resource to be managed, is a relatively recent one appearing with the publication of the IPCC's Fifth Assessment Report in 2013 (Lahn 2021, 5). This assessment report marked a shift from a prior emphasis on the stabilization of greenhouse gas emissions and atmospheric concentrations of CO₂ to one that established a global carbon budget, fixing cumulative carbon dioxide emissions to a level that was capped by the target of limiting warming to 2 degrees Celsius, and later 1.5 degrees Celsius, above pre-industrial levels (Lahn 2021). By connecting the goal of reducing GHG emissions to the figurative notion of a financial budget, the notion of a global carbon budget has captured the attention of a range of actors and catalyzed responses within policy, finance, corporate, and public sectors. It has also succeeded in mobilizing a broad public imagination, as in the Guardian's Carbon Countdown Clock which counts the time left before the world surpasses the IPCC's 2 degree Celsius target at current emissions levels (Evershed 2017).

To some extent, the notion of the carbon budget, more than that of stabilizing emissions, has unleashed more radical, transformative politics, with climate strikes, direct action, and campaigns to leave fossil fuels in the ground sometimes also appropriating the notion of a budget (see Lahn 2021, 4–5). In this vein, the notion of a global carbon budget can create political and discursive space for distributional questions of how and among whom this budget is to be allocated (Neumayer 2000). Notions of carbon deficits and debt similarly raise questions about how these are to be serviced, although they have also sparked concern because of the discursive openings they create for leveraging concrete interventions including negative emissions technologies such as carbon capture and storage, solar radiation management, and other technologies to not only reduce deficits or debts but even to underwrite overshoots or expansions of the global budget (Asayama, Hulme, and Markusson 2021, 1; Mazzai 2021).

Though agriculture's principal emissions – methane and nitrous oxide – are not captured in strict scientific formulations of carbon budgets which are limited to carbon dioxide, in the wake of the IPCC's Fifth Assessment Reports (AR5), as well as the Special Reports on Global Warming of 1.5°C and Climate Change and Land, published between the fifth and sixth assessment cycles, agriculture has become more central in the way that budgets are reckoned with (IPCC 2019, 2014, 2018). Within scientific communities, it has been noted that remaining within a carbon budget of 580 Gigatonnes demands a 'substantial concurrent reduction of agricultural emissions' and that achieving this will not be possible without such reductions (Leahy, Clark, and Reisinger 2020, 2). Others, however, have sounded a note of caution at the aptness of the carbon budget, particularly in relation to agricultural greenhouse gas emissions, noting that cumulative

budgets cannot account for the complexity and dynamism of agricultural emissions (Lahn 2021).

Mitigation action, nonetheless, continues to be configured using accounting terms such as budgets and balance sheets. These vernaculars have, in turn, spawned others – notably they have created the conditions of possibility for notions such as Net Zero and climate neutrality. Promoted by advocacy programs such as the UNFCCC's (2021) 'Race to Zero' campaign, the notion of net-zero and climate neutrality have become a central focus in recent scientific and political discussions (Asayama, Hulme, and Markusson 2021, 2; Tanaka and O'Neill 2018; Rogelj et al. 2021). These ambitions are increasingly translated into programs and interventions at varying scales, gathering force among a wide swath of actors in the scientific, government and policy, as well as private and financial sectors. In a recent presentation, Miguel Taboada from the Argentinian Institute of Agricultural Research (INTA) remarked that carbon neutrality works like an accounting balance sheet 'we have to make a balance between the level of GHG emissions that we are producing... and the possibility to compensate those emissions' (Taboanada 2021, min 10). Here, we see how in an era of global climate change, the classic accountant's balance sheet, which normally displays net-revenues, is reworked to instead display net carbon emissions. Principles of double-entry book-keeping, part of what was so crucial for the development of early capitalism in northern Italy (Mills 1994), are now applied in the management of carbon accounts and budgets.

Yet, the global framing of the carbon budget and its balance sheet obscures the unequal responsibility that different countries have had in the creation of a 'carbon deficit' (Neumayer 2000; Callahan and Mankin 2022). Environmental activists, as well as heads of state and coalitions of countries of the Global South, argue that industrialized countries are responsible for the largest amount of CO₂ emissions that have been historically produced and that are currently accumulated in the atmosphere. At the same time, the effects of climate change are disproportionately felt in poorer countries that have less financial and technological capacities to respond (Newell 2022; Arsel 2022; Borrás Jr. et al. 2022). In struggles for climate justice, the accounting logics implied in the balance sheet have facilitated the emergence of debates about how climate debt is construed, as well as loss and damage and climate reparations. Industrialized countries have a 'climate-debt' with countries of the South and should take the lead reducing carbon emissions and funding climate adaptation programs (Pickering and Barry 2012; Khan et al. 2020). As an illustration, Tom Athanasiou, from the EcoEquity nonprofit, suggests that the U.S. has over used its share of the global carbon-budget: 'we can't meet our moral and practical burdens simply by reducing our own emissions; we've already put so much carbon into the air (and hence reduced the space that should rightly go to others) that we need to make amends' (McKibben 2020). Such notions of climate debt have led to the (so far unfulfilled) financial pledge from industrialized countries to commit USD 100 billion towards adaptation and resilience in the South from 2020, and they animate long-standing efforts to secure binding international commitments on loss-and-damage, as was evident most recently in COP27.

Framing climate justice in terms of debt is symptomatic of the power of accounting and finance in climate change discussions, but also signals some of the dangers that this entails. The development of climate vernaculars – budgets, balance sheets, and debts – work to mobilize climate action, frame mitigation, and inform policy responses

to climate change, and to orient investment. In so doing, GHG emissions become a 'resource' to be managed and governed. In a similar way, carbon emission reductions are turned into a resource that can expand the carbon budget and be traded as carbon offsets. However, this economic strategy defined by carbon budgets, emission rights, and offsets trading, depends on a perfectly calibrated calculative landscape where GHG emissions are accurately measured, emission rights effectively distributed, and emission reductions certified and verified. Despite its questionable efficacy, this strategy is already producing new streams of revenue linked to the production and trade of GHG emission reductions. Such reductions often result from the conjoined mobilization of human labor and more-than-human capacities (often referred to as natural capital, ecosystem services, or nature-based solutions) to capture and store greenhouse gases, such as photosynthesis and soil carbon sequestration. In achieving this, accounting is instrumental in making visible and measurable new forms of more-than-human work/energy as the basis for still more capital accumulation (Moore 2015, 2017, 2018).

Mitigation, accounting, and agrarian relations

When it comes to agrarian relations, carbon accounting must be understood as more than a technical, calculative exercise but a social and political process that may transform local realities. As discussed in the previous section, carbon accounting simplifies the multiple relations that lie behind the production of GHG emissions, by translating them into commensurable substance—units of CO₂ equivalent. It also helps to frame climate mitigation interventions through economic language of balance-sheets, budgets, and debt, and disembeds greenhouse gas emissions from the socio-environmental relations that produce them. Although some degree of disembedding necessarily accompanies efforts to quantify agricultural emissions, it is equally important to attend to what such disembedding enables: that is to say, what historical and socio-environmental relations are obscured through accounting frameworks, and what kinds of relations are enabled by it. From this perspective, it becomes possible to see that in extending the epistemic and discursive dimensions of accounting into agrarian settings, the deployment of quantifying infrastructures that account for GHG emissions on the ground are reconfiguring local agrarian landscapes, re-organizing ecosystems and economic activities, to render them amenable to quantification. In this manner, GHG emissions are re-embedded in agrarian relations within the parameters of carbon accounting and through novel quantification infrastructures.

Carbon accounting helps to render GHG emissions a resource that can be mined and extracted through quantification protocols and methodologies aimed at their mitigation, either in absolute terms or, as is often the case with net zero and carbon neutrality pledges, in terms of emissions intensity. In the process, new infrastructures and networks of agricultural production in which accounting practices are embedded are transforming agrarian worlds. Particularly notable is the way that carbon accounting revolves around the production of data about GHG emissions, the reductions of which can be monetized in carbon and agricultural markets. However, the need to produce data about mitigation efforts influences the shape of mitigation action in agriculture in ways that can further the uniformization of agrarian practices and promote the scaling-up of industrial agricultural production. Carbon accounting in agriculture also expands the reach that some

institutional actors have over agrarian settings, strengthening their authority to reshape and centralize production processes and data collection. In so doing, carbon accounting has an impact over farmers' productive autonomy and can influence the role that farmers' play in the future of agriculture.

Consider two corporate mitigation initiatives led by the US company Indigo Ag and the Argentinian company Bioceres Crop solutions. These agricultural inputs providers have attracted increasing attention in the last decade because of their commitment to reduce the global agricultural carbon footprint. In 2019, Indigo Ag was named the 'World's most innovative company' by CNBC disruptors list (CNBC 2019), while some of the technologies of Bioceres have been deemed of national interest by the Argentinian senate (Silva 2020). Some of the star products of these companies include microbial seed treatments that act as plant growth promoters and that can allegedly reduce the need for agrichemical products, contributing to the reduction of GHG emissions (mainly carbon dioxide, nitrous oxide emitted in the production of fertilizers). These companies also promote their clients' adoption of agricultural practices that can increase soil carbon sequestration, such as the use of cover crops and no-till farming.

To promote their microbial products and the adoption of good agricultural practices, Indigo and Bioceres have created mitigation programs that aim at scaling up their mitigation goals with the help of farmers (Indigo Ag 2022; Bioceres Crop Solutions 2022a). Farmers' who want to reduce their GHG emissions can join these programs but they have to commit to follow specific crop management practices, use particular products and provide data about their agricultural practices, inputs and plots (for example, the history of deforestation, rotation crops, agrochemical use, tilling practices). This data is then used to estimate the carbon footprint of particular crops and to support the certification of crops as low carbon or carbon neutral. In return for farmers' compliance, these programs provide monetary compensation. Bioceres pays up to 30 USD per hectare to farmers that provide data allowing the company to keep product traceability of their products (Bioceres Crop Solutions 2022a). Indigo Ag promises to pay farmers 75% of the profits resulting from mitigation efforts (Indigo Ag 2022). These examples show that as corporate coordination of carbon accounting initiatives scale up mitigation efforts, they can also increase corporate control of agricultural value chains. They can motivate centralized networks of agricultural production managed by corporate actors, in which farmers are instructed, and in some cases even legally obliged, to use certain products and adopt particular agricultural practices.

Clearly, the goal of these corporate mitigation programs is not only to promote GHG emission reductions in agriculture but also to create new streams of revenue linked to the commercialization of carbon credits and low carbon products. The capacity of agri-food companies such as Indigo and Bioceres to turn GHG emission reductions into an economic resource depends not only on their ability to enrol farmers and promote recommended agricultural practices, but also on their capacity to calculate and certify GHG emission reductions according to acceptable standards. Thus, mitigation programs follow accepted standards of carbon accounting ensuring that their mitigation achievements can be certified. For example, Indigo's 'Carbon' program helps farmers to certify their GHG emission reductions through the VERRA VM00042 methodology, so that they can be transformed into tradeable carbon credits (Indigo Ag 2022). The productive networks promoted by corporate mitigation programs are thus shaped around highly

technical calculating efforts where companies control the accounting knowledge (even designing their own accounting methodologies as Indigo's VM0042), and where farmers become data providers sharing data about their production processes.

The production of GHG emission reductions as a resource is not, however, equally feasible for all agricultural actors. Compliance with carbon accounting standards is technically complex and the certification process is expensive, which prevents, small and less capitalized farmers from measuring, certifying, and monetizing their mitigation achievements on their own. Even large companies such as Bioceres require assistance when trying to produce certifiable GHG emission reductions. While Bioceres is currently not seeking to produce carbon credits as is Indigo, the company aims at certifying agricultural products to be sold in specialty markets at more attractive prices (or at least to ensure that they comply with increasingly stringent environmental regulations).⁶ To reach this goal, Bioceres has joined the 'Programa Argentino Carbono Neutro' (PACN), which supports Argentinian agricultural producers in calculating their GHG emissions and communicating their mitigation achievements to agricultural markets through the labeling of certified carbon neutral products (PACN 2020).⁷

While these corporate programs create new streams of revenue that are shared with farmers, the corporate control of these networks means that these benefits come to farmers at the cost of less productive autonomy. Although not all mitigation programs depend on the coordination of corporate actors, for example public and non-governmental actors are also leading mitigation efforts, all of those we have encountered in our research across Argentina, Canada, and Colombia rely on top-down coordination and centralized networks of production. For example, the Colombian public program *Vision Amazonia* brings together indigenous and peasant communities in the Colombian Amazon to work against deforestation and forest degradation, leading to carbon emission reductions that are later exchanged against international cooperation funds (Visión Amazonía 2022). These funds are then distributed to local projects related to forest conservation and agroforestry. The centralized and top-down associative nature of mitigation efforts is related to the data requirements of carbon accounting frameworks. *Vision Amazonia* has a large pedagogical component to train local communities on the environmental and economic benefits of transforming their land-use and agricultural practices, as well as on the need to monitor and keep records of their progress. Therefore, although this type of program is not run by corporate actors, it is still reliant on the governance of local practices by external actors to fulfill the requirement of carbon accounting methodologies.

A new Colombian program called *Biocarbono* aims at producing low-carbon agrarian landscapes (Biocarbono 2022) with a similar result-based methodology to that of *Vision Amazonia*. The program promotes changes in land-use that increase soil carbon

⁶The production of certified low carbon crops follows a similar logic to that of other goods produced for specialty markets (e.g. organic, clean, fair-trade). However, unlike organic and fair trade certifications that produce particular qualities (Galvin 2021), carbon accounting participates in a substantially different type of capitalization where GHG emission reductions become a commodity in themselves through the process of verification and certification.

⁷The PACN offers three main tools for this purpose: a series of manuals of good practices that can help farmers reduce their GHG emissions; a carbon calculator that can be used to estimate the amount of GHG emissions and emission reductions; and product stamps to differentiate the products that are part of the program in agricultural markets. The strictest of the three stamps offered by the PACN certifies that a farmer's production has achieved carbon neutrality. This stamp must be supported by internationally recognized standards so that any mitigation achievements are also recognized in international agricultural markets.

sequestration, such as the replacement of cattle-ranching for cocoa and palm oil agroforestry projects, in regions heavily affected by deforestation or with a high potential for afforestation such as the Colombian Orinoquía. This country-based program is part of the World Bank Biocarbon Fund's Initiative for Sustainable Forest Landscape (ISFL). The ISFL is financed by international cooperation funds and supports agrarian mitigation programs in five different countries of Latin America, Africa and South East Asia. The initiative has a strong focus on carbon accounting (ISFL 2022), seeking to build the technical capacity of participant countries so that they can carry out the measurement, reporting and verification (MRV) of their programs' GHG emission reductions and removals. The data produced by these MRV systems could then be used to justify the disbursement of Biocarbon funds against certified GHG emission results. These disbursements would compensate local actors and communities for their involvement in these programs.

The objectives of the corporate and national mitigation programs discussed so far are not completely the same, but the production of GHG emission reductions as a resource is conditioned by the implementation of carbon accounting frameworks in both types of initiatives. The standards of carbon accounting produced by VERRA are amongst the most widely used for AFOLU (Agriculture, forestry and land use) projects, including more than thirty methodologies. Both Indigo and the Biocarbon Fund have helped to produce VERRA methodologies for the AFOLU sector (VERRA 2011, 2020), while also being positioned to benefit from them, something that we have also observed in the development of carbon offsets for agricultural emissions in the Canadian province of Alberta.⁸ Most of these methodologies are aimed at forestry and afforestation projects such as REDD+. However, six of them are directly related to agricultural production (VERRA 2022a), including projects of crop and land management such as the restoration of grazing land through forest plantations, the replacement of chemical fertilizers by organic compost, and the shifting of continuous and unrestricted grazing for planned rotational grazing, amongst others.

Carbon accounting frameworks can influence the types of agriculture that are promoted by mitigation action and the actors that they target. Judging by the VERRA registry (VERRA 2022b), where all the projects using VERRA methodologies are listed, reforestation projects and methodologies predominate over agricultural projects (out of 260 registered AFOLU projects, only six follow methodologies directed at the agricultural sector). The involvement of small farming communities in these projects is prominent in reforestation and agroforestry interventions (such as Vision Amazonia) where GHG emission reductions are achieved through the improvement of forest coverage. The low number of agricultural projects can be indicative of the challenges posed by carbon accounting methodologies for this sector in general, and for small-scale farming in particular. For example, methodologies that involve life-cycle assessments and that require product traceability (such as those implemented in the mitigation programs of Indigo and Bioceres) are more easily implemented in large-scale monocultures than in polyculture farming, where lack of crop uniformity makes product traceability difficult. Moreover, small-scale farming does not offer the same level of scalability for mitigation initiatives, which means that the

⁸Indigo produced the VM00042 methodology for improved agricultural land management (VERRA 2020) and the Biocarbon Fund produced the VM00017 methodology for the adoption of sustainable agricultural land management (VERRA 2011).

economic benefits of implementing carbon accounting methodologies are less attractive. This explains in part why corporate programs usually target industrial farmers of export-oriented monocrops. For example, farmers involved in the Bioceres program cultivate an average of 229 hectares of land (Bioceres Crop Solutions 2022b).⁹

Besides issues of uniformity and scalability, farmers' active participation in mitigation projects so far remains an important condition for the popularization of carbon accounting methodologies in agriculture. Gathering and sharing the data required by carbon accounting methodologies places an additional burden of work on farmers, discouraging them from joining mitigation programs or from strictly following their guidelines of data collection. To face this challenge, agri-food companies deploy field teams to fill data gaps while also coming up with strategies to 'make it easier for farmers to gather the data they need to earn certified carbon credits' (Bomgardner and Erickson 2021 Q16], 14). Companies such as Bayer are testing pilot projects where data gathering and record keeping is automated with the help of precision agricultural machinery, satellite information and digital platforms. These automation strategies may simplify carbon accounting in agriculture but they can also influence the types of agriculture that carbon accounting promotes. Such strategies are often designed and carried out by agri-food corporations that can afford such heavy investment and risk, but they enable industry concentration in large-scale monocrop agriculture. Automation strategies can also disproportionately attract mitigation finance, which is 'inclined towards sectors or emission sources where quantification and monitoring of the mitigation benefits is relatively easy' (FAO 2019, 6).

Finally, automation strategies deployed to simplify the practice of carbon accounting can promote imaginaries of the future that displace farmers from their central role in agricultural production. The CEO of Okaratech, the company that manages Bioceres' digital platform in Argentina, imagines a type of agriculture where satellites, drones, mechanical planters, harvesters and fumigators communicate with each other in real time through the 'internet of things,' coordinating production and gathering data without farmer involvement. In these imaginaries of the future, farmers play a minimal role because they are perceived as an obstacle to data gathering and record keeping. Thus, if these imaginaries of the future of agriculture materialize, they could have serious implications for the role of farmers in agricultural production, and for food sovereignty and productive autonomy among other things.

Even if these imaginaries do not gain traction, carbon accounting is already affecting the type of agricultural production promoted by mitigation initiatives. Mitigation programs are creating new configurations of institutional power and alliances as corporate, state, and non-governmental actors position themselves as expert intermediaries between farmers' practices and mitigation ambitions. This is leading to the emergence of new forms of agricultural governance that are premised on the production, centralization, and control of GHG emission data to be either exchanged for cooperation funds, or certified and monetized. Such moves threaten farmers' productive autonomy, and they may reproduce perceptions of farmers as dependent on assistance and expert guidance

⁹Bioceres program has grown from involving 25 wheat farmers in 2020 to 225 wheat farmers in 2022 and from 15 soy producers in 2020 to 103 farmers in 2022. These farmers produce soy on 23 thousand hectares of land and wheat on 53 thousand hectares of land.

or as obstacles to agricultural modernization, while also generating new demands on labor as farmers become subjected to the guidelines of carbon accounting frameworks.

Conclusions: reimagining accounting, advancing agrarian counter-accounts

Accounting is a field of knowledge and a form of professional practice; it is also a way of viewing the world, and a force that participates in re-making it. In this article, we have examined its particular force along three different dimensions – as epistemology, instrument, and narrative – and explored how and with what effects it is being operationalized through corporate and public climate mitigation interventions in agrarian settings. What emerges as notable from this study is the particular role that accounting tools and methods play in disembedding carbon dioxide and its CO₂e counterparts from the socio-ecological and political-economic relations in which they are produced, while vocabularies, concepts, and narratives do the work of *amplifying* accounting as a means of apprehending and responding to climate change. Throughout, the tight relation between accounting, governance, and management has helped to keep climate change as a primarily ‘problem of emissions.’

In this way, accounting must be acknowledged as a condition of possibility for the expansion and deepening of capitalist accumulation in the midst of, and even through, environmental crises. Accounting comes to shape accumulation pathways in situated and particular ways as agrarian environments and relations are brought into the fold of climate mitigation. In the foregoing discussion we have noted that accounting is a force that must be reckoned with in relation to long-standing concerns in agrarian studies with questions of land and labor, as well as more recent ones such as knowledge, data, and nonhuman life and worlds. What forms of accounting and accounts are demanded and produced in the name of climate mitigation? By whom, for whom, and with what effect? As agrarian peoples and places come to be governed through regimes of climate mitigation and low-carbon agriculture, these are some of the questions that we suggest need to be asked and addressed in grappling analytically and politically with both novel and abiding processes of accumulation.

At the same time however, we also look with interest toward the imaginative promise of what the critical accounting scholar Robert Gray (2010) and several of his collaborators have called ‘counter-accounts.’ Counter-accounts are those that leverage the power and versatility of accounting vocabularies in order to render or take account differently (Gray, Brennan, and Malpas 2014; Gray 2010). Accounting-giving, account-taking, and account-holding are, in this expanded sense, profoundly social practices that can both open, and foreclose, different political potentials. Indeed, while carbon accounting becomes subsumed by the values and representational forms of financial accounting, some critical accountant scholars have reacted by arguing that ‘there is no a priori reason for restricting accounts to any particular form of representation, any particular medium of expression’ (Gray, Brennan, and Malpas 2014, 262). Instead, we should recognize that accounts can ‘cut across pretty much any other category of existence we might choose – be it (say) language, literature, organizations, families or markets’ (2014, 262), and that there are multiple ways in which different collectives produce accounts of their existence. Along these lines, such multiple avenues for giving and holding account may open up other

ways of figuring climate change in a way that resists the reductionism of a focus on emissions, and that can be harnessed in struggles for what Borrás and Franco (2018) have termed agrarian climate justice. Current examples of counter-accounts can be found in mobilizations around climate debt, loss and damage, and unequal ecological exchange.

Emergent forms of what we call agrarian counter-accounts are located at different sites and scales of social, political, and epistemological practice. Some forms of agrarian counter-accounts may not eschew the quantitative logics of accounting entirely, but instead seek to harness them toward different ends. Along these lines, ecological economists have developed modes of account-taking that seek to make legible and quantifiable global environmental injustices, accounting for the unequal flow of virtual soil (Pengue 2017; Zuberman 2019), virtual water (Dalin et al. 2012) and GHG emissions across different geographies of the world (Van Houtan et al. 2021). Whilst still relying on quantitative methods and in some instances also the conceptual parameters of 'natural capital,' the forms of evidence that are generated by these sorts of counter-accounts may be used to support arguments for environmental reparations, compensation, and loss-and-damage, by demonstrating how the cost of pollution and environmental degradation is unequally distributed. They also contribute to wider efforts to center justice in climate change responses, by 'undoing equivalence' (Carton, Lund, and Dooley 2021) and attending to questions of restitution, recognition, and redistribution (Borrás and Franco 2018). Community-based approaches, on the other hand, give and take account of local environmental change in ways that extend far beyond methods of measuring and estimating GHG emissions. Some examples of these approaches include social cartographies about the evolution of local ecosystems (Rodríguez 2010), as well as literary accounts of local environmental change (Fujikane 2021). These are but a few examples that point to a range of possible agrarian counter-accounts that may be given, taken, and held, and which exceed the narrow scope of accounting for climate change by accounting for emissions alone. Cumulatively, they show that as much as carbon accounting may be a powerful tool for enabling new forms of accumulation in agrarian settings, agrarian worlds equally offer an important political location from which to develop accounts that mobilize against longstanding practices extraction, exploitation, and unequal exchange.

At the same time, in creating an opening toward the imaginative political and emancipatory potential of counter-accounts, it is worth bearing in mind Audre Lorde's caution 'the master's Tools will never dismantle the master's house' (Lorde 1983). To the extent that accounting has been crucial in the emergence and expansion of capitalism and capitalist accumulation in new domains, it is uncertain whether it can be re-purposed in struggles for climate justice, agrarian and otherwise. So thoroughly have responses to climate change been 'rendered technical' by accounting knowledges and interventions, that the question arises whether accounting in any form can be a means not only for challenging or identifying processes of exclusion and deepening inequality, but for pursuing alternatives that would give substance to robust and meaningful climate justice. What kinds of reimagination of accounting would this entail? What accounts must be taken, given, and to what ends? For now, these remain open questions. But, given the way that accounting has taken firm hold in modes of responding to and engaging with the climate crisis, these may yet be questions worth asking.

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