The Rio Branco Declaration: Assessing Progress Toward a Near-Term Voluntary Deforestation Reduction Target in Subnational Jurisdictions Across the Tropics

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Voluntary commitments are playing an ever-greater role in environmental governance at all scales. In the years preceding the signing of the Paris Agreement in 2015, a flurry of non-state and state actors signed on to various declarations and commitments to reduce deforestation as one globally significant climate mitigation solution. This paper focuses on the Rio Branco Declaration (RBD) and the 30 first-order subnational jurisdictions located in Brazil, Indonesia, Mexico, and Peru that signed it between 2014 and 2018, committing to reduce deforestation 80% by 2020, conditional upon adequate support from the international community. We assess each study jurisdiction's progress toward that commitment in terms of reducing deforestation, and examine a subset of the potential factors supporting or slowing progress, including the existence of commensurate targets within jurisdictions' legal frameworks and the international financial support pledged to jurisdictions. We found that progress toward achieving the target was slow and likely unattainable in most jurisdictions outside of Brazil. Among the four jurisdictions likely to achieve the target under current deforestation trajectories, only Mato Grosso State has a target within its legal framework that is more ambitious than the RBD target. We found that the international response to the RBD was sluggish and likely inadequate – with only one financial pledge made in direct response to the declaration and the majority of funding to support jurisdictional efforts coming from one source. We did not find a clear relationship between international finance pledged and progress toward the RBD deforestation target; however, more often, jurisdictions that received pledges earlier have made more progress. We explore what may explain individual jurisdictions' performance with respect to the target, including specific jurisdictional circumstances, national context, and international support. We estimate that, if current deforestation trajectories continue, the RBD signatories in our study could contribute approximately 3.7% (0.65 GtCO$_2$e) of the greenhouse gas emissions reduction needed to keep global warming at 1.5°C, compared with a potential 5.7% (0.98 GtCO$_2$e) if they were to all meet the RBD target.

Keywords: tropics, deforestation, jurisdictional approach, performance targets, environmental governance, climate change

INTRODUCTION

Tropical deforestation accounts for 11 to 14% of global CO_2 emissions (IPCC (Intergovernmental Panel on Climate Change), 2018), and thus has been a focus of proposed regional and global climate mitigation solutions for over a decade (Santilli et al., 2005; Kindermann et al., 2008; Griscom et al., 2017). The years preceding the signing of the Paris Agreement in 2015 were marked by a flurry of declarations and other commitments by governments, both national and subnational, and private companies to reduce tropical deforestation (Hsu et al., 2015). Many national governments included general references to forest emissions reductions in their Intended Nationally Determined Contributions (INDCs, later NDCs) leading up to the Paris Agreement (Grassi et al., 2017), while private companies signed on to Zero Deforestation Commitments and similar pledges in droves (Lambin et al., 2018; Rothrock et al., 2019). Subnational governments in the tropics signed the Rio Branco Declaration (RBD), the New York Declaration on Forests (NYDF, also signed by national and private actors), and the Under2 MOU (U2MOU, which encompasses a broader set of emissions sources than forests) (GCF TF, 2014; NYDF Global Platform, 2014; The Climate Group, 2015). Whereas the NDCs are planned to go into effect only after 2020, the majority of the corporate and subnational pledges were intended to achieve impacts by 2020 (Hsu et al., 2015; Lambin et al., 2018, Ludwig, 2018).

Voluntary commitments are playing an ever-greater role in environmental governance at all scales, in many cases exceeding the ambition of those that are legally binding (Brown Weiss, 2014). Historically, voluntary, non-binding legal instruments have played an important role especially in the formulation of international environmental law, and have often served as a first step in the negotiation of binding agreements (Schaffer and Pollack, 2010; Brown Weiss, 2014). More recently, the proliferation of voluntary commitments by non-national governments and actors reflects a shift from more top-down, formal agreements negotiated among nation-states to a more bottom-up and multi-level and/or polycentric approach to solving complex environmental problems (Boyd, 2010; Bulkeley et al., 2014; Jordan et al., 2015). Nowhere is this truer than with respect to climate change mitigation and adaptation, including in regard to tropical deforestation and land use. The role and potential impact of voluntary commitments by subnational governments in the tropics has not been well-studied, largely due to their relative novelty.

Subnational jurisdictions such as states and provinces are increasingly promoted as a strategic level of government engagement for reducing greenhouse gas (GHG) emissions from land-use change (Nepstad et al., 2013; Anderton and Setzer, 2018; Boyd et al., 2018). In part, this follows on several decades of national governments shifting responsibilities to subnational governments in decentralization processes (Agrawal and Ribot, 1999). Subnational governments (including cities) have been at the forefront of innovation in developing and implementing programs to reduce GHG emissions and sequester carbon (Engel, 2006; Anderton and Setzer, 2018, but see Jordan and Huitema, 2014; Gustafsson and Scurrah, 2019). They are

thought to be closer to the farmers, rural communities and other stakeholders who control forest lands (Boyd et al., 2018; Rodriguez-Ward et al., 2018; Stickler et al., 2018a) and who elect the representatives making land use policy decisions (Agrawal and Ribot, 1999). Furthermore, public policy innovations, such as the *Cadastro Ambiental Rural* (Rural Environmental Registry) of Brazil (Roitman et al., 2018) and inter-municipal governance systems functioning in some Mexican states (Libert-Amico and Trench, 2016), often originate and are tested in subnational jurisdictions (Anderton and Setzer, 2018). Skeptics of the approach cite subnational governments' lack of relevant or appropriate authority, related to national governments' centralizing tendencies, including control over budgets (Ribot and Larson, 2012; Libert-Amico and Trench, 2016); in fact, subnational jurisdictions often have authority over critical areas related to climate change (Agrawal, 2001; Anderton and Setzer, 2018, Busch and Amarjargal, 2020). Critics further cite lack of capacity – from human to financial – to implement changes (Larson and Soto, 2008; Setzer, 2015, Libert-Amico and Larson, 2020) and the possibility that subnational governments will be co-opted by actors whose actions tend to promote deforestation (Willis et al., 1999; Ravikumar et al., 2018).

As part of their efforts to pursue climate action, many subnational governments participate in transnational networks (Betsill and Bulkeley, 2006; Setzer, 2015). Ostensibly, these platforms allow governments to share experiences, participate in collective action, gain attention, and alter power dynamics with respect to national governments (Setzer, 2015; Di Gregorio et al., 2019). The Governors' Climate and Forests Task Force (GCF TF), established in 2009, is one such platform. A collaboration among 38 mostly tropical subnational jurisdictions from 10 countries, the GCF TF focuses on jurisdictional approaches to REDD+ and low-emission development (Boyd et al., 2018). In 2014, 13 members of the GCF TF endorsed the RBD (GCF TF, 2014). Since then, 25 additional member governments have signed the Declaration.

The RBD stipulates that its aim to reduce deforestation 80% by 2020 is contingent upon sufficient, long-term financial support to signatories' jurisdictional low-emission development programs being made available by the international community. In addition to committing to reduce deforestation, signatories vowed to develop partnerships to support private sector efforts to achieve deforestation-free supply chains, and to channel a significant share of performance-based funds to indigenous peoples (IP), smallholders, and other forest-dependent communities (DiGiano et al., 2020). The potential annual emissions reduction of 0.98 $GtCO_2e$ associated with achievement of the RBD represents 5.7% of the reductions needed to keep global temperatures below 1.5° C (IPCC (Intergovernmental Panel on Climate Change), 2018).

In this study, we assess and interpret progress made by 30 RBD signatories. We first estimate signatories' progress toward the central target of the RBD: to reduce deforestation 80% by 2020. We also provide an indication of the point in time at which they will theoretically achieve the committed reduction, if not by 2020, based on current deforestation trends. Next, we examine the extent to which the commitment made under the RBD are reflected within signatories' relevant

laws, regulations and policies, based on the expectation that an important indicator of a government's intent to fulfill its commitments is whether commensurate targets have been incorporated into the jurisdiction's legal and policy framework. Finally, to evaluate the conditional aspect of the RBD, we catalog the international financial support provided to the signatory jurisdictions with the objective of supporting policies and actions to reduce deforestation. We conclude with a discussion of how these factors, among other conditions specific to each jurisdiction, may be related to jurisdictions' respective progress toward the RBD target.

DATA AND METHODS

Study Sites

Our study focuses on 30 first-order administrative divisions (e.g., states and provinces) within four tropical countries (**Figure 1**). The sample includes nine Brazilian states (all the Brazilian Legal Amazon states; 60% of total national territory), seven Indonesian provinces (46% of national territory), seven Mexican states (17% of national territory), and seven Peruvian Amazon regions (56% of national territory) (**Table 1**). All 30 subnational jurisdictions are members of the GCF TF and are among the 35 signatories to the RBD (signed between 2014 and 2018). Collectively, the study jurisdictions contain 26% of the world's tropical forests, 51.8 GtC of forest carbon, and represent nearly 98% of the total remaining tropical forest area contained in all RBD signatory territories (Stickler et al., 2018b).

Progress Toward RBD Target
Deforestation Data

To evaluate progress toward jurisdictional targets assessed in the study, we collected historical annual deforestation data for the reference period defined by each respective target through the most recently reported observations. We obtained deforestation data from the official forest monitoring systems of Brazil, Indonesia, Mexico, and Peru, respectively (Stickler et al., 2018b; **Supplementary Text S1**). For each country, this information is produced for national and subnational levels, based mainly on interpretation of Landsat satellite images. The published deforestation data meet the required levels of consistency to be used in the definition of national forest reference emission levels (FRELs) and land use activities included in national GHG emissions inventories. We used the most recent deforestation data released for Peru (2018), Indonesia (2017), and Mexico (2015). We did not use Brazil's most recently published preliminary deforestation figures from 2019, due to anticipated discrepancies with the final figures; we used 2018 data, instead.

Baselines

Deforestation baselines are standard benchmarks used to set and assess progress toward deforestation reduction goals, and are frequently based on historic trends defining a "business-as-usual" trajectory (Angelsen, 2008; Huettner et al., 2009, Karsenty et al., 2014). Since the RBD does not define a specific baseline, we used the same criteria used by each country to define its FREL in its REDD+ contribution submitted to the United Nations Framework Convention on Climate Change (UNFCCC) (**Supplementary Text S2** and **Supplementary Table S1**). Thus, for Brazilian states, the RBD baseline is defined as the average annual deforestation rate from 1996 to 2010. However, nearly all the Brazilian states defined the deforestation targets in their published state plans using the average annual deforestation rate from 1996 to 2005 as the baseline. To harmonize these with the RBD commitment in order to make a comparison, we translated legal targets (those incorporated into jurisdictions' legal frameworks) into areal deforestation targets by 2020. Peru defines its baseline by projecting a linear increase of deforestation observed between 2000 and 2014, instead of an average of recent years. Indonesia
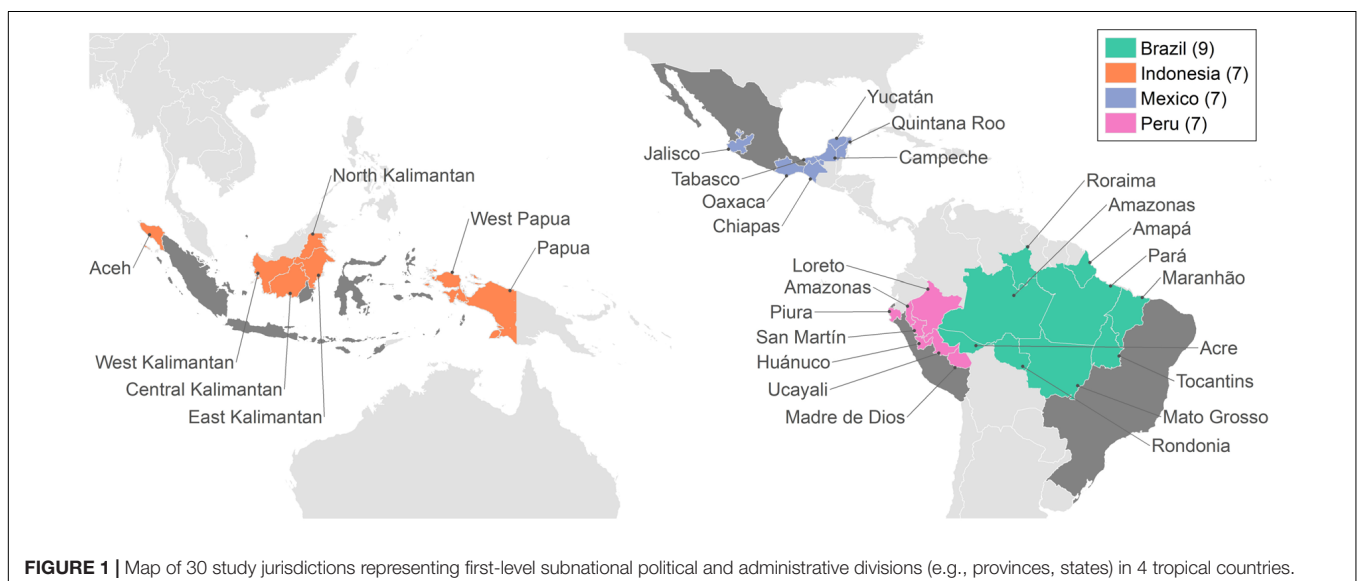

FIGURE 1 | Map of 30 study jurisdictions representing first-level subnational political and administrative divisions (e.g., provinces, states) in 4 tropical countries.

TABLE 1 | Total surface area, original forest area, and current forest area of study jurisdictions.

Country	Jurisdiction	Area (km^2)	Original forest area (km^2)	Current forest area	
				km^2	% of jurisdiction
Brazil	Acre (AC)	164,124	163,568	143,048	87%
	Amapá (AP)	142,829	113,107	110,340	77%
	Amazonas (AM)	1,559,149	1,458,477	1,423,095	91%
	Maranhão (MA)	331,937	143,963	42,138	13%
	Mato Grosso (MT)	903,378	520,033	314,716	35%
	Pará (PA)	1,247,954	1,129,705	873,585	70%
	Rondônia (RO)	237,591	211,071	122,719	52%
	Roraima (RR)	224,303	160,568	150,532	67%
	Tocantins (TO)	277,721	39,853	9,963	4%
Indonesia	Aceh (AH)	56,776	56,223	30,370	53%
	Central Kalimantan (CK)	153,559	152,131	70,538	46%
	East Kalimantan (EK)	128,031	125,940	65,249	51%
	North Kalimantan (NK)	68,996	68,192	56,236	82%
	Papua (PP)	313,374	296,188	248,332	79%
	West Kalimantan (WK)	146,954	142,126	54,545	37%
	West Papua (WP)	98,593	95,764	88,219	89%
Mexico	Campeche (CM)	57,924	41,781	40,144	69%
	Chiapas (CS)	73,289	70,698	32,494	44%
	Jalisco (JA)	78,599	63,757	43,768	56%
	Oaxaca (OA)	93,793	88,584	67,377	72%
	Quintana Roo (QR)	42,361	34,650	34,812	82%
	Tabasco (TB)	24,738	14,576	3,071	12%
	Yucatán (YU)	39,612	36,022	26,307	66%
Peru	Amazonas (AZ)	39,249	35,697	28,317	72%
	Huánuco (HU)	36,849	23,375	15,460	42%
	Loreto (LO)	368,852	363,677	350,479	95%
	Madre de Dios (MD)	85,301	82,955	79,057	93%
	Piura (PI)	35,893	839	415	1%
	San Martín (SM)	51,253	47,969	33,445	65%

defines its baseline by the average annual deforestation rate in the period from 1990 to 2012. For Mexico, the baseline is defined by the average deforestation of the 2000 to 2010 period.

Estimating Progress Toward RBD Target

To estimate jurisdictions' progress toward achieving the RBD target, we converted the target to the area equivalent to an 80% reduction below each respective jurisdiction's baseline. We then computed each jurisdiction's current deforestation level as the weighted average of the three most recent annual deforestation figures to offset the effect of extreme differences in deforestation in a single year and therefore better reflect the current trend (**Supplementary Text S2**). Finally, we compared this value with the calculated RBD target. When reporting progress toward the RBD target, an 80% decline in deforestation below the baseline corresponds to 100% progress toward the RBD target.

We also estimated the year by which study jurisdictions are likely to achieve the RBD target, by extrapolating each

jurisdiction's current deforestation trajectory (a linear projection from the baseline at the time of endorsement to current levels, as defined above) to the year that an 80% reduction below the baseline would be reached. For jurisdictions with increasing deforestation trajectories, we could not estimate the date of achievement based on current trends.

Brazilian Cerrado Biome

The Amazon and Cerrado biomes are treated separately under Brazilian law (Government of Brazil (GOB), 2012), and deforestation within each biome is reported separately (de Brito et al., 2018; INPE (Instituto Nacional de Pesquisas Espaciais), 2020). Three states (Maranhão, Mato Grosso, and Tocantins) in our analysis contain substantial areas of Cerrado biome (**Supplementary Table S2**), thus we conducted separate analyses for these states' Cerrado and Amazon biomes. The RBD specifically references forests and was originally designed with the Amazon forests in mind, in the case of Brazil. The broad definition of the Cerrado biome encompasses a significant amount of savanna woodland, grasslands and dry forest; however,

we adopted the narrower Cerrado definition provided in Brazil's Cerrado Reference Emission Level submission to the UNFCCC which considers only forest formations and their corresponding carbon pools (MMA, 2017).

Jurisdictions' Legal Targets

Identification of Targets

We scrutinized national and subnational environmental policies and plans to catalog existing targets for reducing deforestation established within the legal and policy framework of each jurisdiction. We refer to these as "legal targets" throughout the manuscript, even in cases in which a given target is not incorporated into a jurisdiction's legal code. We used the most recent version of each policy or plan available, in cases where multiple revisions or iterations exist. We previously identified the policies and plans through a comprehensive assessment carried out in these jurisdictions in 2017 and 2018, which included compilation of secondary data and interviews with key stakeholders in each jurisdiction (Stickler et al., 2018b). We supplemented that assessment through consultations with national experts who are knowledgeable of the relevant legal and institutional frameworks affecting the jurisdictions in the context of environment and REDD+. From each source, we collected the following information about the target: the intended quantitative reduction, the intended target date, the baseline against which the reduction is measured, the geographic extent over which the target applies, and the year in which the legislation was established.

Alignment Between Jurisdictions' Legal Targets and RBD Targets

We compared the years in which each jurisdiction's legal target was established with the year in which it signed the RBD to obtain an indication of the extent to which the RBD may have influenced establishment of the legal target. We also analyzed the correspondence between the RBD commitment to reduce deforestation 80% by 2020 and each study jurisdiction's legal targets. We developed the following classification to assess alignment between legal targets and the RBD target, in terms of the quantity of reduced deforestation and the target year:

- Less Ambitious

  (a) The legal target is not both measurable and time-bound; or
  (b) The legal target has the same term as the RBD target or a term farther in the future, but a lower quantitative goal; or
  (c) The legal target has the same quantitative goal as the RBD target, but with a term farther in the future.

- Equally or More Ambitious

  (a) The legal target is exactly the same as the RBD target, in terms of both quantitative goal and target date; or
  (b) The legal target date has the same term as the RBD target, but has a greater quantitative goal; or
  (c) The legal target has the same quantitative goal as the RBD target, but with a nearer-term target.

- Unable to Compare

  (a) The legal target may be measurable in theory but not in practice (e.g., the goal requires measurement of net forest loss).
  (b) The legal target measures net or illegal deforestation, whereas the RBD target measures gross deforestation; or
  (c) The legal target does not apply to the entire jurisdiction (e.g., only some 2nd order administrative units), whereas the RBD target is jurisdiction-wide; or
  (d) The legal target appears to be based on unreliable or otherwise flawed information (e.g., the target is impossible given total forest extent, etc.).

- N/A

  (a) No legal target is identified for the jurisdiction.

Contribution of Legal and RBD Targets to NDC

As a measure of the targets' broader importance, we estimated the potential contribution of each measurable legal target under full compliance with the respective NDC emissions reduction targets (**Supplementary Table S3**). To make jurisdictional and national targets comparable, we extrapolated to 2030 (NDC target date) the projected emissions reductions under compliance with each respective legal target, assuming continued compliance where the legal target date is nearer-term. For jurisdictions with a measurable target that is not time-bound, we set a target date of 2030 in order to compare it with the NDC (**Supplementary Text S3**). We then calculated the projected emissions reductions of the legal targets as a percent of the corresponding country's projected NDC emissions reductions. We were unable to carry out this analysis for Peru, because the data used to develop Peruvian regions' legal targets are unavailable and derived differently than those used to develop the NDC.

We also estimated the potential contribution by each jurisdiction (including those in Peru) to its respective NDC emissions reduction goal assuming full compliance with the RBD target, using the same methodology described above for legal targets.

Finally, we estimated the potential contribution of reduced emissions from deforestation by each jurisdiction to its respective NDC, assuming that current deforestation rates hold through 2030. We first computed the difference in emissions associated with the current level of deforestation and the emissions associated with deforestation observed in the NDC base year (**Supplementary Text S3** and **Supplementary Table S3**). We then compared this value to the all-sector emissions reductions goal of the NDC pledge.

For Brazilian jurisdictions, we carried out these analyses only for the Amazon biome. For Acre, Maranhão, Mato Grosso, and Pará, which have more than one legal target (**Table 2**), we calculated each state's contribution to the NDC based only on the target laid out in their respective state Plan for the Prevention and Control of Deforestation (PPCD).

International Financial Support

To provide an indication of international financial support for reducing deforestation in the focal jurisdictions, we identified the amounts and sources of international finance pledged to each jurisdiction from 2010 to 2019, using publicly available information. We chose 2010 as the starting year because of its relevance as the year following the UNFCCC COP15 negotiations in Copenhagen, which marked a shift in interest beyond national state actors. As we were not able to reliably confirm disbursement of finance to jurisdictions for most sources, we only considered pledged finance.

Pre- Versus Post-RBD Funding

To obtain an indication of how much international climate finance was pledged to signatories after the RBD was made public, we separated funding sources into pre-RBD (2010–2014) and post-RBD (2015–2019) categories. We distinguish between post-RBD funding that is directly related to the announcement of the RBD, versus that which is not, but is nevertheless designated to support efforts to reduce deforestation. We assigned individual funding sources to one time period or the other according to the date the funding was initially pledged or contracted. We considered all finance pledged in 2015 or later to be post-RBD, even if the jurisdiction to which finance was pledged had not yet signed the RBD. Since the initial signing and public declaration in 2014 of the RBD signaled a global call for funding, this division allows us to most conservatively assess the direct and indirect effects of this call on the international community's interest in offering financial support.

Scope of Activities Included

We included forest-related finance pledged to the jurisdictional level. We define forest-related finance as encompassing programs or activities with the specific goal of reducing deforestation or emissions from deforestation, and those supporting forest monitoring systems, sustainable production systems, maintenance of conservation areas, reforestation or afforestation projects, community or IP/LC forest management, rural land titling, prevention and monitoring of forest fires, and subnational contributions to national REDD+ or other forest-related strategies (**Supplementary Text S4**). We did not restrict our analysis only to initiatives that cover the entire areal extent of the jurisdiction. We included funding to lower-level administrative units within a jurisdiction relevant to the jurisdiction's deforestation reduction goals (e.g., protected areas, or areas with historically high deforestation due to concentration of extractive or productive industries), or that focus on key constituencies within a jurisdiction (e.g., forest stewards, agents of land-cover change). We also identified forest-related finance pledged at the country level in cases where the funding contributes to jurisdictional approaches within the given country (**Supplementary Text S4** and **Supplementary Table S4**).

Conditional Finance

We identified the amount of the total pre- and post-RBD finance that could be directly attributed to a jurisdiction being an RBD signatory, based on whether RBD signature is a stipulation of receiving the finance or if the funding source otherwise referenced the RBD specifically. Additionally, we determined the amount of direct results-based finance (RBF). We labeled funds as "results-based" if the funds are conditional upon measured reductions in deforestation or emissions from deforestation, using the accepted definition of RBF as payments "conditional on the demonstration of results through quantitative performance indicators" (van der Hoff et al., 2018; **Supplementary Text S4**).

Currency Conversions

To enable comparison, we converted all funding amounts to US Dollars (USD). When the original source listed only non-USD currency amounts, we converted the given values to USD using an historical currency conversion database (OANDA, 2020), using the average exchange rate over the year in which the finance was pledged or contracted since we could not always confirm the exact date (**Supplementary Table S4**).

RESULTS

Progress Toward RBD Target

Half (15) of the study jurisdictions have made some progress toward achieving the RBD commitment (**Figure 2**). For these jurisdictions, progress ranges from 12 to 104% of the 80% reduction goal achieved. Most Brazilian jurisdictions have made positive progress toward their RBD commitment, with the exception of Amazonas (−43%). Most of the progress made by Brazilian states was achieved before 2015, when those states rapidly reduced their deforestation rates due to a mix of command-and-control policies, increased law enforcement capacity, and territorial performance approaches (e.g., suspending farm credit in local government jurisdictions) (Nepstad et al., 2014). The three states with the highest historical deforestation rates – Mato Grosso, Pará, and Rondônia – have all advanced at least 50% toward the target. Mato Grosso has achieved 93% and 87% of the target in the Amazon and Cerrado biome areas, respectively. The two other high-achieving jurisdictions are Tocantins and Maranhão, both Cerrado-dominated states (**Supplementary Table S2**). Tocantins has more than exceeded the RBD target in its Amazon biome area, but has made more moderate progress in the Cerrado biome (51%). The Amazon biome comprises only 9% of the state's area, an area smaller than any other Brazilian state's currently remaining Amazon forest expanse (**Supplementary Table S2**).

The remaining seven advancing jurisdictions are distributed among the three other countries. In Indonesia, three jurisdictions have made progress toward the RBD goal. Papua is one of the highest achievers among the study sample, having reached 82% of the goal (**Figure 2**). West Papua has instead increased deforestation relative to its baseline; however, as it has among the lowest historical deforestation rates in the group of study jurisdictions (**Supplementary Table S2**), it does not require a large increase in deforestation to exceed the target value. All Mexican states have increased deforestation with respect to the baseline (**Figure 2**). In contrast, four Peruvian jurisdictions demonstrated progress toward the goal. San Martín is halfway
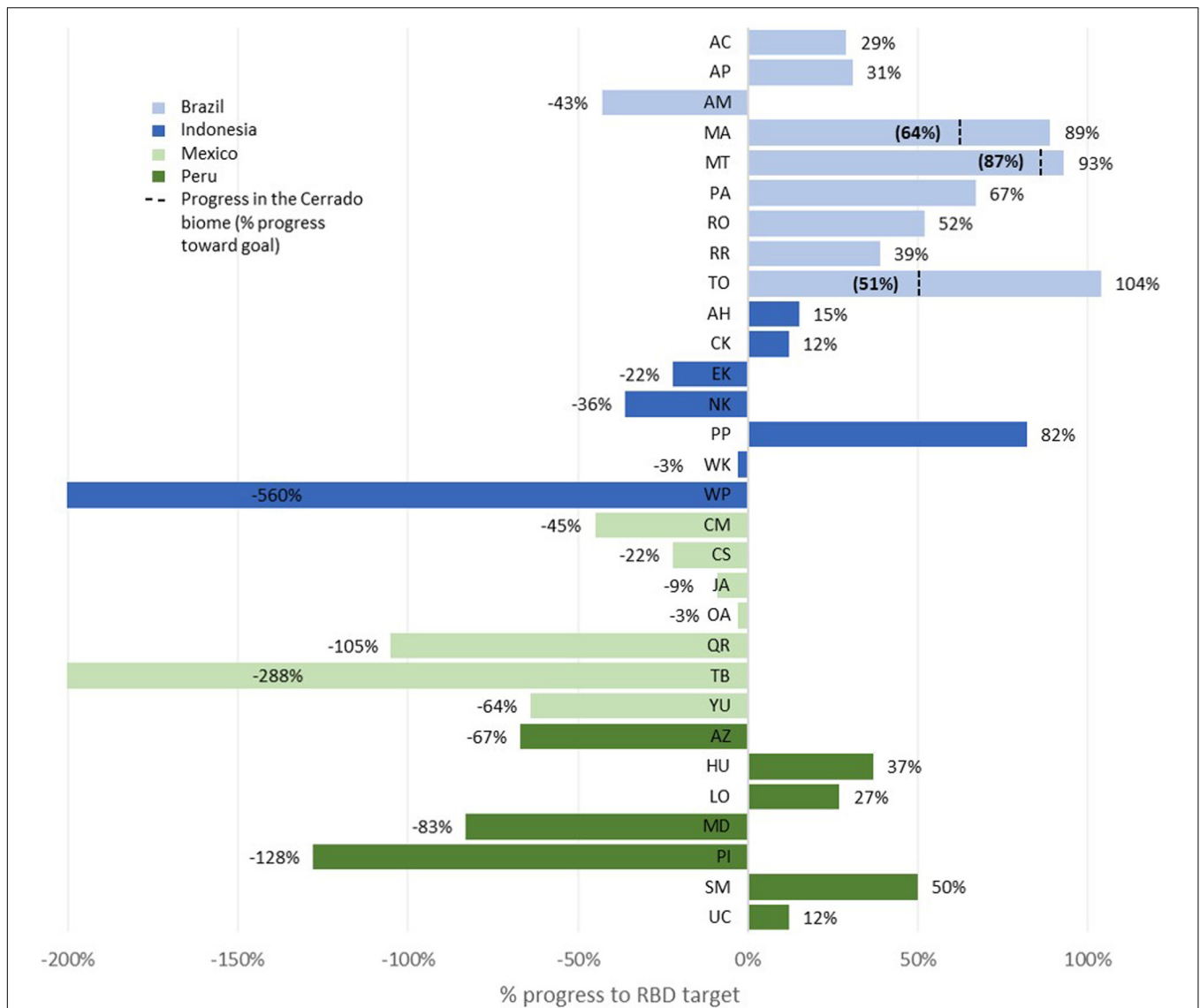
FIGURE 2 | Jurisdictions' progress toward achieving the RBD deforestation reduction target as a percent of full compliance. A value of 100% or greater indicates that the RBD target has been reached or exceeded. A negative value indicates that the jurisdiction is increasing deforestation with respect to the baseline.

to meeting the target, whereas Huánuco, Loreto, and Ucayali have achieved 37, 27, and 12% of the goal, respectively. The other Peruvian regions have increased deforestation relative to the baseline (**Figure 2**).

Projected Date of Fulfillment of RBD Target

We estimated that only four jurisdictions are projected to achieve the 80% reduction in deforestation by 2020: Mato Grosso, Maranhão, Tocantins, and Papua (**Figure 3**). Mato Grosso is also likely to meet the target for its Cerrado forest area. Another six jurisdictions could meet the goal by 2030: Pará, Rondônia, Roraima, San Martín, Huánuco, and Loreto. Additionally, Maranhão and Tocantins could achieve the target for their Cerrado forest areas. The remaining five jurisdictions with demonstrated

progress to date are projected to achieve the target only after 2035, assuming that the current deforestation trajectories hold.

Targets in Legal Frameworks: Alignment With RBD Target

We found that 26 of the 30 study jurisdictions have at least one legal target for reducing deforestation (**Tables 2–5**). However, fewer than half of those are advancing toward the RBD goal (**Figure 2**). Furthermore, we found that voluntary commitment to the RBD did not generally influence the definition of legal targets. More typically, jurisdictions signed onto the RBD regardless of their legal target and did not adjust their target to align with the RBD. Seventeen of the 26 jurisdictions with at

FIGURE 3 | Year in which each jurisdiction is projected to achieve the RBD deforestation reduction target based on current deforestation trajectories.
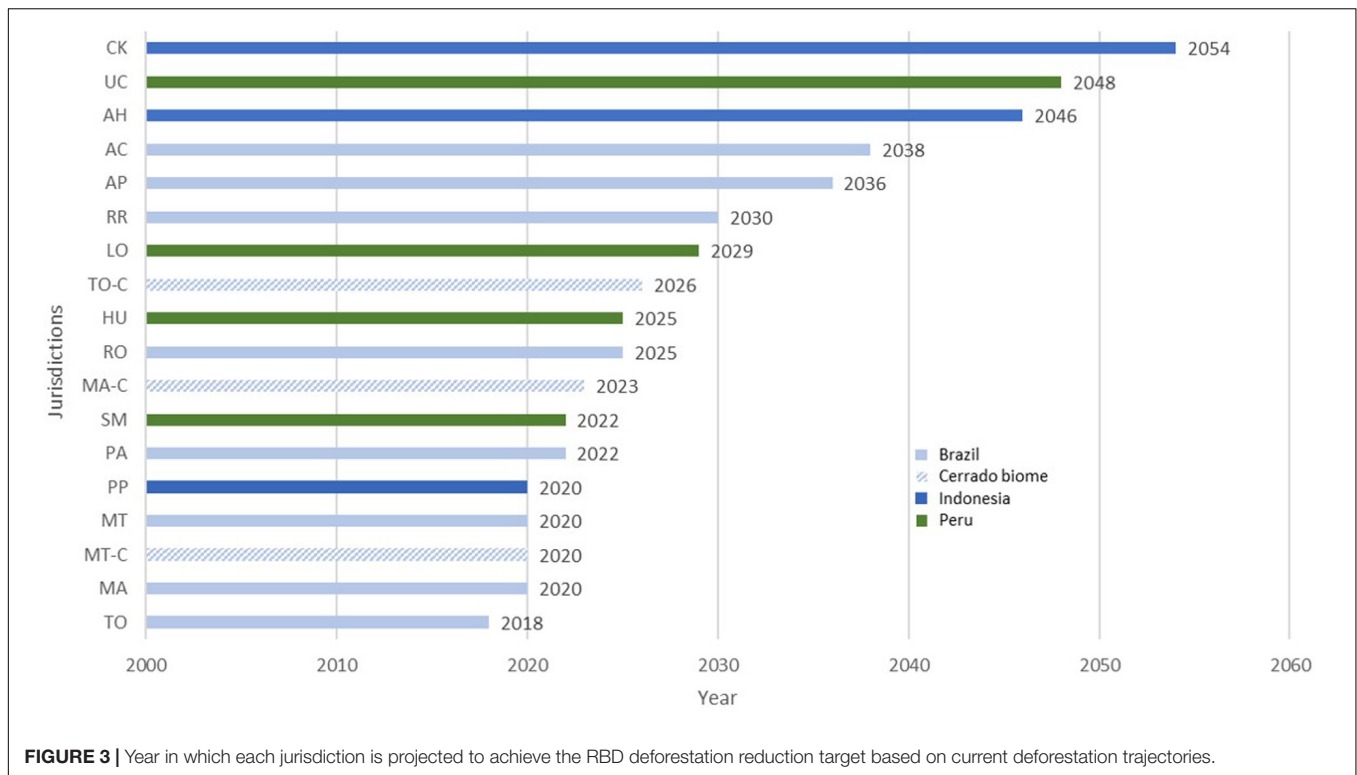
least one legal target already had it in place before they signed the RBD. Eight of these have demonstrated progress toward the RBD target. In contrast, seven jurisdictions established their targets only after they signed the RBD. Of these, three have made progress toward achieving the RBD: Acre, Rondônia, and Ucayali (**Figure 2**). Acre falls into both groups, since one target (PPCD) was established in 2010, and the other (Zero Illegal Deforestation Agreement) in 2015.

When we evaluated the extent to which legal targets align with the RBD target, we found that only 2 of the 30 study jurisdictions have at least one target that is equally or more ambitious than the RBD target: Mato Grosso and Central Kalimantan (**Tables 2–5**). We note, however, that the Central Kalimantan target is not directly reflected in the provincial legal framework but rather in a political declaration which requires separate regulation to be implemented (Plantation Office of Central Kalimantan (POCK), 2013). Sixteen jurisdictions have at least one legal target that is less ambitious than the RBD target; these include Mato Grosso, which also has one that is equally or more ambitious (**Table 2**). Eleven jurisdictions have at least one legal target which we were unable to compare to the RBD in terms of ambition (see section "Alignment Between Jurisdictions' Legal Targets and RBD Targets") – several of these jurisdictions also have targets that are comparable to the RBD target (**Tables 2–5**). Even the legal targets set by nine jurisdictions which signed the RBD in 2017 or 2018 (after the first opportunity under Funding Window A of Norway's pledge to GCF TF jurisdictions, administered by the United Nations Development Program [UNDP], and the attending eligibility criteria were announced; see section "International Financial Support") were not adjusted to meet the RBD, nor were any of them comparable with or at least as ambitious as the RBD.

Contribution of Legal and RBD Targets to NDC

In Brazil, jurisdictions' legal targets, if met, could collectively comprise over 70% of the emissions reductions goal outlined in Brazil's NDC, equivalent to approximately 865 $MtCO_2e$ y^{-1} (**Table 6**). The potential contribution of Mato Grosso and Pará collectively accounts for half of the overall NDC target, with Rondônia accounting for an additional 15%. In our projection, full achievement of the RBD by Brazilian jurisdictions collectively could contribute nearly 863 $MtCO_2e$ y^{-1} in emissions reductions or just over 70% of Brazil's NDC goal (**Table 6**). This is roughly equivalent to the reductions potentially achieved by full compliance with the legal targets.

Under a scenario of full compliance, the legal targets of Indonesian provinces in our study could collectively contribute less than 20% to the overall Indonesian NDC goal, with Central Kalimantan and East Kalimantan together accounting for the majority of these contributions. Indonesian signatories to the RBD could potentially contribute 23% to the Indonesian NDC target by achieving the RBD – approximately 5% more than the contribution of their legal targets.

For Mexican states, the potential collective contribution of jurisdictions' legal targets is 6.2%. The potential contribution associated with achieving the RBD goal is 8.5% of the overall NDC target.

TABLE 2 | Inventory of deforestation targets ("legal targets") of the nine GCF TF member jurisdictions located in Brazil.

Jurisdiction	Year of RBD signature	Goal	Quantity	Target year	Baseline	Equally as or more ambitious than RBD	Target source
AC	2014	Reduce deforestation	80%	2020	1996–2005*	N	PPCD-AC (Secretary of Environment of the State of Acre (SEMA), 2010)
		Reduce illegal deforestation	100%	2020	N/A	○	Zero Illegal Deforestation Agreement (MMA, 2015)
AP	2014	Avoid increasing emissions of CO_2 and other GHG associated with deforestation and burning of native vegetation	N/A	N/A	N/A	N	PPCD-AP (Government of the State of Amapá, 2009)
AM	2014	Reduce deforestation	55%[1]	2020	1996–2005*	N	PPCD-AM (Secretary of Environment and Sustainable Development of the State of Amazonas, 2014)
MA	2018	1. Reduce deforestation in the Amazon 2. Reduce deforestation in the Cerrado 3. Reduce illegal deforestation	1. 80% 2. 50% 3. 100%	2020 (all)	1996–2005*	1. N 2. ○ 3. ○	PPCDQ-MA (Secretary of the Environment and Natural Resources of the State of Maranhão, 2011)
MT	2015	Reduce illegal deforestation	100%	2020	N/A	○	Zero Illegal Deforestation Agreement (MMA, 2015)
		1. Reduce illegal deforestation 2. Reduce deforestation 3. Reduce deforestation in the Cerrado	1. 100% 2. 90% 3. 95%	1. 2020 2. 2030 3. 2030	2001–2010*	1. N 2. N 3. ○	PCI (Mato Grosso Produce Conserve Include (PCI) Strategy, 2015)
		Reduce deforestation	80%	2020	2001–2010*	Y	PPCDQ-MT (Secretary of Environment of the State of Mato Grosso, 2013)
PA	2015	Reduce deforestation	80%	2020	1996–2005*	N	PPCAD (State Government of Pará, 2009)
		Reduce net deforestation	100%	2020	N/A	○	Rio+20 Governor's announcement (WWF, 2012)
RO	2015	Reduce illegal deforestation	100%	2020	1996–2005*	○	PE (State Superintendence of Strategic Affairs of the State of Rondônia, 2016)
RR	2017	Reduce annual deforestation	21%[2]	2020	1996–2005*	N	PPCDQ (Government of the State of Roraima, 2011)
TO	2015	1. Reduce deforestation in the Amazon 2. Reduce illegal deforestation in the Cerrado	1. 75–80% 2. 100%	N/A	1996–2005*	1. N 2. N	PPCDQ (Government of the State of Tocantins, 2015)

Y, yes; N, no; ○, unable to compare; N/A, not applicable; * denotes that baseline differs from baseline used for RBD goal. [1]The target as written is: Maintain average annual deforestation rate limited to 350 kmkm^2 y^{-1} or less between the period of 2011–2020. We calculated this to be a reduction of ~55% from the baseline. [2]The target as written indicates a progressive reduction, ultimately reaching a deforestation rate of 188.96 km^2 y^{-1} by 2020. We calculated this to be a reduction of ~21% from the baseline.

Full compliance with the RBD target in Peru could potentially contribute 73% to the overall NDC goal; San Martín Region alone contributes just over a quarter of the Peruvian NDC target. As noted in the section "Data and Methods," we were not able to make a projection for legal targets in Peru.

However, most jurisdictions are not on a path to achieving the RBD by 2020, and half are increasing their deforestation with respect to their baselines (**Figures 2**, **3**). If current levels of deforestation hold, we estimate that Brazilian jurisdictions would contribute 54% to Brazil's NDC emissions reduction target – nearly 20% less than if they fully met the RBD target or fully complied with established legal targets. The potential contributions of Mato Grosso and Pará under this more realistic scenario account for 40% of the NDC target. Indonesian jurisdictions are on a current deforestation trajectory that would contribute merely 1.7% of the country's NDC target. This represents a 21.3% decrease from their potential contributions if they fully achieved their RBD target. If current deforestation rates hold, Mexican jurisdictions will likely make a near-negligible contribution to the country's NDC target at 0.1%. Peruvian jurisdictions are increasing their deforestation rates relative to their baselines and are on a trajectory to increase emissions from deforestation, adding 3.68 MtCO$_2$e y^{-1} which will need to be compensated by other sectors in order for Peru to achieve its NDC goal.

International Financial Support
Timing and Conditions

Overall, we found that study jurisdictions received more funding before announcement of the RBD than after. Combined, study jurisdictions were pledged USD 315 million in the five years before the RBD was announced, but only USD 288 million in the five subsequent years. Nevertheless, more individual jurisdictions (25 of 30) were pledged a greater value of finance in the post-RBD period, compared with

TABLE 3 | Inventory of deforestation targets ("legal targets") of the seven GCF TF member jurisdictions located in Indonesia.

Jurisdiction	Year of RBD signature	Goal	Quantity	Target year	Baseline	Equally as or more ambitious than RBD	Target source
AH	2015	Forests become a net carbon sink	N/A	2030	1990–2012	○	SRAP REDD+ (Provincial Government of Aceh (PGA), 2013)
CK	2014	Reduce deforestation	80%	2020	2006–2009*	Y	Roadmap to Low-Deforestation Rural Development (Plantation Office of Central Kalimantan (POCK), 2013)
EK	2015	Reduce net deforestation	100%	2025	1990–2012	○	Kaltim Green (Provincial Government of East Kalimantan (PGEK), 2010)
		Forests and land become a net carbon sink	N/A	2030	N/A	○	SRAP REDD+ (Provincial Government of East Kalimantan (PGEK), 2011)
NK	2018	N/A	N/A	N/A	N/A	N/A	N/A
PP	2015	N/A	N/A	N/A	N/A	N/A	N/A
WK	2014	Reduce deforestation, forest degradation and emissions from peat decomposition	60%	2020	1990–2012	N	SRAP REDD+ (Provincial Government of West Kalimantan (PGWK), 2016)
WP	2014	Reduce deforestation and degradation due to forest conversion	N/A	N/A	N/A	N	SRAP REDD+ (Provincial Government of West Papua (PGWP), 2012)

Y, yes; N, no; ○, unable to compare; N/A, not applicable; * denotes that baseline differs from baseline used for RBD goal.

TABLE 4 | Inventory of deforestation targets ("legal targets") of the seven GCF TF member jurisdictions located in Mexico.

Jurisdiction	Year of RBD signature	Goal	Quantity	Target year	Baseline	Equally as or more ambitious than RBD	Target source
CM	2017	1. Reduce annual net deforestation 2. Reduce net deforestation	1. 80% 2. 100%	1. 2020 2. 2030	2000–2010	1. ○ 2. ○	EEREDD+ (Secretary of Environment and Sustainable Resource Use of the State of Campeche, 2015)
CS	2014	Reduce deforestation significantly	N/A	2020	N/A	N	EEREDD+, in update (Pronatura Sur, 2017)
JA	2014	Reduce net deforestation	100%	2030	2000–2010	○	EEREDD+ (Secretary of Environment and Territorial Development of the State of Jalisco (SEMADET), 2017)
OA	2018	Reduce net deforestation	100%	2030	2000–2010	○	EEREDD+, in update (Secretary of Environment, Energy and Sustainable Development of the State of Oaxaca (SEMAEDESO), 2016)
QR	2014	Reduce area of deforestation	80%	2030	2000–2010	N	EEREDD+ (Secretary of Ecology and Environment of the State of Quintana Roo (SEMA), 2017)
TB	2014	N/A	N/A	N/A	N/A	N/A	N/A
YU	2018	Reduce net deforestation	100%	2030	2000–2010	○	EEREDD+ (Government of Yucatán, 2017)

Y, yes; N, no; ○, unable to compare; N/A, not applicable.

before. Twenty-one of those had no pledged finance pre-RBD, including all jurisdictions in Indonesia and Mexico. Eighteen jurisdictions received post-RBD finance only from UNDP-Norway; sixteen of those had no prior finance pledged (**Table 7**).

The UNDP-Norway funding is the only finance source that we can confirm to have emerged in direct response to the RBD. The government of Norway announced a total funding pledge of NOK 200 million (approximately USD 24 million) to GCF TF jurisdictions in 2015, within a year after the RBD became

TABLE 5 | Inventory of deforestation targets ("legal targets") of the seven GCF TF member jurisdictions located in Peru.

Jurisdiction	Year of RBD signature	Goal	Quantity	Target year	Baseline	Equally as or more ambitious than RBD	Target source
AZ	2015	Reduce annual deforestation rate	50%	2021	2012	N	PRAA (Regional Government of Amazonas, 2014)
HU	2017	N/A	N/A	N/A	N/A	N/A	N/A
LO	2015	Limit accumulated deforestation	to 1.5 million ha	2021[3]	2013	○	PDRC (Regional Government of Loreto, 2015)
MD	2017	Reduce annual deforestation	~61%[4]	2021	2015	N	PDRC (Regional Government of Madre de Dios, 2017)
PI	2017	Reduce net rate of deforestation	80%	2021	20,822 ha y^{-1}	○	PRAA (Regional Government of Piura, 2016)
SM	2015	Reduce annual deforestation	~71%[5]	2021	2014	N	PDRC (Regional Government of San Martín, 2015)
UC	2014	Reduce deforestation	~42%[6]	2021	2014	N	PEI (Regional Government of Ucayali, 2016)

Y, yes; N, no; ○, unable to compare; N/A, not applicable. [3]The PDRC document lists this same quantitative goal twice: on page 72, it is listed with the target year of 2030, while on page 149, the target year is 2021. We consider 2021 the target year, since it is more ambitious. [4]The target appears in the document as: Reduce deforestation to 5000 ha/year by 2021 – from 2015 baseline of 12,810 ha. We calculated this decrease to be approximately 61%. [5]The target appears in the document as: Reduce annual deforestation from 20,564 ha (2014) to 6012 ha by 2021. We calculated this decrease to be approximately 71%. [6]The target appears in the document as: Reduce deforestation from 32,884 ha (2014) to 18,974 ha by 2021. We calculated this decrease to be approximately 42%.

public (Barrett and Calderon, 2015). This total includes two specific opportunities, or "funding windows" as UNDP refers to them: Window A proposals for jurisdictional investment plans (USD 12 million total; up to USD 400,000 per jurisdiction), and Window B Innovation Fund for jurisdictional transformation (USD 5 million total; up to USD 500,000 per jurisdiction) (UNDP (United Nations Development Programme), n.d.). Our analysis includes the finance pledged through Window A (which we refer to as "UNDP-Norway finance"), as Window B was not yet open at the time of the analysis. UNDP was designated to manage the pledges in 2017, at which time jurisdictions were required to be signatories as a condition of applying for Window A funding (i.e., to sign the RBD if they had not already) (GCF TF, 2018; UNDP (United Nations Development Programme), n.d.). Thus, each study jurisdiction became eligible to receive up to USD 400,000 as a direct result of signing the RBD.

Of the five jurisdictions that did not receive more funding post-RBD than pre-RBD, four are in Brazil (Acre, Pará, Rondônia, Tocantins); the other is in Peru (San Martín). Almost all Brazilian states received pledges of finance pre-RBD—an average of USD 31.52 million per state; in contrast, most jurisdictions in other countries received no pledges at all prior to signing the RBD. The vast majority of funding to Brazilian states comes from the Amazon Fund, which was established with funds pledged by Norway in 2008 in recognition of Brazil's decline in deforestation achieved between 2005 and 2007 (Nepstad et al., 2014). Amazon Fund finance represents over half of all funding to Brazilian states and 40% of all funding pledged to all focal jurisdictions between 2010 and 2019.

To date, only Acre and Mato Grosso have been pledged direct RBF. Both states have received funding from the German and United Kingdom governments through the REDD+ Early

Movers (REM) program, since 2012 and 2017, respectively. REM finance is the only source of RBF to both states, and makes up 35 and 53%, respectively, of Acre and Mato Grosso's total pledged finance (Table 8 and Supplementary Table S4).

Trends: Finance Pledged Versus Progress to RBD

We were unable to distinguish between funding destined to deforestation reduction in the Amazon versus Cerrado biomes for Maranhão, Mato Grosso, and Tocantins in all instances and therefore report on progress and funding related to both biomes. The 15 jurisdictions demonstrating progress toward the RBD target received total funding pledges of USD 293.77 million in the five-year period before the RBD was launched (Table 9). In the five years following the RBD announcement, funding pledges to these jurisdictions declined by 43% (USD 127.62 million). However, the median funding per jurisdiction increased from USD 0.61 million to USD 2.90 million. Acre alone received USD 154.77 million in pledges in the pre-RBD period, whereas less than half (six) of the jurisdictions making progress received no pledges prior to 2015. Pledges received pre-RBD by the remaining eight jurisdictions ranged from USD 2.36 million to USD 41.44 million. Post-RBD, all 15 jurisdictions received at least one pledge. Five jurisdictions only received the UNDP-Norway funding post-RBD; for two of these (Tocantins and San Martín), this meant a significant reduction in pledges from the pre- to post-RBD period (98% and 99% declines, respectively). Mato Grosso had the highest amount of funding pledges post-RBD (USD 73.23 million), nearly twice as great as the funding pledges received by Acre (USD 37.35 million). Overall, jurisdictions making progress toward the RBD received USD 459.91 million in pledges between 2010 and 2019.

TABLE 6 | Percent of respective national NDC emissions reduction goal contributed by each jurisdiction under three alternative scenarios: (i) full compliance with legal deforestation reduction target, (ii) full compliance with RBD deforestation reduction target, and (iii) continuation of current deforestation trajectory.

	Legal target		RBD		Current trajectory	
	% contribution	$MtCO_2e\ y^{-1}$	% contribution	$MtCO_2e\ y^{-1}$	% contribution	$MtCO_2e\ y^{-1}$
Brazil	73.5%	865.26	73.3%	862.90	54.0%	637.08
Acre	2.2%	25.96	2.3%	27.23	1.0%	12.02
Amapá	–	–	0.1%	1.49	0.0%	0.57
Amazonas	2.0%	23.38	2.9%	34.05	−1.3%	−15.05
Maranhão	3.4%	40.32	3.5%	40.76	3.1%	36.54
Mato Grosso	28.0%	330.17	27.8%	327.91	26.3%	309.86
Pará	21.7%	255.70	22.1%	260.37	14.9%	175.93
Rondônia	15.2%	178.42	13.1%	153.89	9.1%	106.58
Roraima	0%	0.00	0.4%	4.51	−0.2%	−2.45
Tocantins	1.0%	11.33	1.1%	12.71	1.1%	13.07
Indonesia	17.6%	146.07	22.3.0%	191.73	1.7%	14.40
Aceh	1.7%	14.00	1.4%	11.25	0.2%	1.67
Central Kalimantan	7.8%	65.23	7.7%	63.80	0.9%	7.67
East Kalimantan	5.1%	42.84	4.1%	34.31	−0.9%	−7.49
North Kalimantan	–	–	1.3%	10.70	−0.5%	−3.77
Papua	–	–	3.9%	32.59	3.2%	26.79
West Kalimantan	2.9%	24.00	3.8%	31.33	−0.1%	−0.95
West Papua	–	–	0.2%	1.74	−1.1%	−9.52
Mexico	6.2%	13.28	8.5%	18.11	0.1%	0.14
Campeche	3.0%	6.34	3.0%	6.34	0.0%	0.00
Chiapas	–	–	2.3%	4.91	0.0%	0.00
Jalisco	0.6%	1.32	0.5%	1.08	0.0%	0.00
Oaxaca	1.0%	2.17	0.8%	1.75	0.0%	0.00
Quintana Roo	0.6%	1.36	0.8%	1.62	0.0%	0.00
Tabasco	–	–	0.3%	0.59	0.1%	0.15
Yucatán	1.0%	2.09	0.9%	1.82	0.0%	0.00
Peru	–	–	73.3%	43.71	−6.2%	−3.68
Amazonas	–	–	2.2%	1.19	−3.8%	−2.26
Huánuco	–	–	10.8%	6.56	0.2%	0.11
Loreto	–	–	15.4%	8.95	−1.0%	−0.59
Madre de Dios	–	–	9.8%	5.97	−7.4%	−4.40
Piura	–	–	0.2%	0.00	−0.1%	−0.04
San Martín	–	–	25.8%	15.51	15.0%	8.97
Ucayali	–	–	9.0%	5.37	−9.2%	−5.48

We also provide the collective contribution to the national NDC goal represented by all jurisdictions in each respective country. In some cases, we were unable to calculate the legal target's contribution to NDC, due either to lack of data availability [i.e., Peru (Data and Methods 2.4)] or due to a lack of a measurable legal target (Tables 2–5).

In contrast, the 15 jurisdictions not progressing toward the RBD goal received only USD 143.11 million in funding pledges between 2010 and 2019, or approximately 31% of what was pledged to jurisdictions demonstrating progress in the same time period. Ninety-seven percent of these funds were pledged to East Kalimantan and Amazonas (Brazil) combined. Only Amazonas received funding pre-RBD (USD 21.28 million); all of these funds came from the Amazon Fund. Post-RBD, the other 13 jurisdictions were recipients of the UNDP-Norway funding, receiving an average amount of USD 0.34 million. East Kalimantan and Amazonas received

additional pledges for a total of USD 91.03 million and USD 26.37 million, respectively, in funding pledges post-RBD. Jurisdictions not demonstrating progress were pledged only 7% of what those making progress were pledged in the pre-RBD period. In the post-RBD period, however, this ratio improved as the jurisdictions with increasing deforestation received pledges equaling nearly three-quarters of the total funds pledged to jurisdictions with declining deforestation.

Overall, our analysis suggests that more of the jurisdictions that have reduced deforestation below their baseline saw an earlier input of funds, while nearly all of those that have

TABLE 7 | Total forest finance pledged to 30 RBD signatory jurisdictions from 2010 to 2019, segregated by the amounts pledged in the periods prior and subsequent to the RBD.

	Jurisdiction	RBD signature year	Pre-RBD (2010–2014) USD millions	Post-RBD (2015–2019) USD millions	Total (2010–2019) USD millions
Brazil	AC	2014	154.77	37.35	192.12
	AP	2014	0.61	2.90	3.51
	AM	2014	21.28	26.37	47.66
	MA	2018	2.36	12.59	14.96
	MT	2015	22.40	73.23	95.63
	PA	2015	41.44	7.84	49.28
	RO	2015	24.85	10.34	35.19
	RR	2017	0.00	1.64	1.64
	TO	2015	15.94	0.37	16.31
	Total		*283.65*	*172.63*	*456.28*
	Mean		*31.52*	*19.18*	*50.70*
	Median		*21.28*	*10.34*	*35.19*
Indonesia	AH	2015	0.00	7.59	7.59
	CK	2014	0.00	2.34	2.34
	EK	2015	0.00	91.03	91.03
	NK	2018	0.00	0.30	0.30
	PP	2015	0.00	0.35	0.35
	WK	2014	0.00	0.40	0.40
	WP	2014	0.00	0.34	0.34
	Total		*0.00*	*102.35*	*102.35*
	Mean		*0.00*	*14.62*	*14.62*
	Median		*0.00*	*0.40*	*0.40*
Mexico	CM	2017	0.00	0.36	0.36
	CS	2014	0.00	0.35	0.35
	JA	2014	0.00	0.36	0.36
	OA	2018	0.00	0.39	0.39
	QR	2014	0.00	0.37	0.37
	TB	2014	0.00	0.20	0.20
	YU	2018	0.00	0.38	0.38
	Total		*0.00*	*2.41*	*2.41*
	Mean		*0.00*	*0.36*	*0.36*
	Median		*0.00*	*0.34*	*0.34*
Peru	AZ	2015	0.00	0.39	0.39
	HU	2017	0.00	0.39	0.39
	LO	2015	0.00	8.44	8.44
	MD	2017	0.00	0.20	0.20
	PI	2017	0.00	0.39	0.39
	SM	2015	31.40	0.39	31.79
	UC	2014	0.00	0.39	0.39
	Total		*31.40*	*10.59*	*41.98*
	Mean		*4.49*	*1.51*	*6.00*
	Median		*0.00*	*0.39*	*0.39*
Grand total			*315.05*	*287.97*	*603.02*
Mean			*10.50*	*9.60*	*20.10*
Median			*0.00*	*0.39*	*0.39*

increased deforestation relative to the baseline only began receiving pledges later, largely in the form of the UNDP-Norway pledges (**Supplementary Table S4**). However, we could not detect a direct relationship between amount of funding pledged and extent of progress toward the RBD among the jurisdictions.

TABLE 8 | Total forest finance pledged to study jurisdictions from 2010 to 2019, segregated by the amounts pledged in direct response to RBD and as direct results-based finance.

	Jurisdiction	Total forest-related finance *USD Millions*	Finance pledged in direct response to RBD *USD Millions* (% of jurisdiction total)	Direct results-based finance *USD Millions* (% of jurisdiction total)
	AC	192.12	0.39 (<1%)	66.81 (35%)
	AP	3.51	0.40 (11%)	0.00
	AM	47.66	0.37 (1%)	0.00
	MA	14.96	0.40 (3%)	0.00
Brazil	MT	95.63	0.40 (<1%)	50.89 (53%)
	PA	49.28	0.40 (1%)	0.00
	RO	35.19	0.37 (1%)	0.00
	RR	1.64	0.40 (24%)	0.00
	TO	16.31	0.37 (2%)	0.00
	Total	*456.28*	*3.50*	*117.70*
	Mean	*50.70*	*0.39*	*13.09*
	Median	*35.19*	*0.40*	*0.00*
	AH	7.59	0.40 (5%)	0.00
	CK	2.34	0.32 (14%)	0.00
	EK	91.03	0.33 (<1%)	0.00
Indonesia	NK	0.30	0.30 (100%)	0.00
	PP	0.35	0.35 (100%)	0.00
	WK	0.40	0.40 (100%)	0.00
	WP	0.34	0.34 (100%)	0.00
	Total	*102.35*	*2.43*	*0.00*
	Mean	*14.62*	*0.35*	*0.00*
	Median	*0.40*	*0.34*	*0.00*
	CM	0.36	0.36 (100%)	0.00
	CS	0.35	0.35 (100%)	0.00
	JA	0.36	0.36 (100%)	0.00
	OA	0.39	0.39 (100%)	0.00
Mexico	QR	0.37	0.37 (100%)	0.00
	TB	0.20	0.20 (100%)	0.00
	YU	0.38	0.38 (100%)	0.00
	Total	*2.41*	*2.41 (100%)*	*0.00*
	Mean	*0.34*	*0.34*	*0.00*
	Median	*0.36*	*0.36*	*0.00*
	AZ	0.39	0.39 (100%)	0.00
	HU	0.39	0.39 (100%)	0.00
	LO	8.44	0.40 (5%)	0.00
	MD	0.20	0.20 (100%)	0.00
Peru	PI	0.39	0.39 (100%)	0.00
	SM	31.79	0.39 (1%)	0.00
	UC	0.39	0.39 (100%)	0.00
	Total	*41.98*	*2.55*	*0.00*
	Mean	*6.00*	*0.36*	*0.00*
	Median	*0.39*	*0.39*	*0.00*
	Grand total	*603.02*	*10.88*	*117.70*
	Mean	*20.10*	*0.36*	*3.92*
	Median	*0.39*	*0.38*	*0.00*

DISCUSSION

"We call upon donor governments and the private sector to work with us to mobilize additional capacity-building and pay-for-performance funds....

We call upon donor governments, the private sector, standards developers, and civil society groups to work with us to develop simple and robust performance metrics that will allow our jurisdictions to access results-based financing today.

TABLE 9 | Total forest finance pledged to study jurisdictions from 2010 to 2019, ranked according to jurisdictions' progress toward the RBD deforestation reduction target.

	Jurisdiction	Progress toward RBD (%)	Pre-RBD (2010–2014) *USD millions*	Post-RBD (2015–2019) *USD millions*	Total (2010–2019) *USD millions*
Progress toward RBD	TO *(TO-C)*	104 (51)	15.94	0.37	16.31
	MT *(MT-C)*	93 (87)	22.40	73.23	95.63
	MA *(MA-C)*	89 (64)	2.36	12.59	14.96
	PP	82	0.00	0.35	0.35
	PA	67	41.44	7.84	49.28
	RO	52	24.85	10.34	35.19
	SM	50	31.40	0.39	31.79
	RR	39	0.00	1.64	1.64
	HU	37	0.00	0.39	0.39
	AP	31	0.61	2.90	3.51
	AC	29	154.77	37.35	192.12
	LO	27	0.00	8.44	8.44
	AH	15	0.00	7.59	7.59
	CK	12	0.00	2.34	2.34
	UC	12	0.00	0.39	0.39
	Total		*293.77*	*166.15*	*459.91*
	Mean		*19.58*	*11.08*	*30.66*
	Median		*0.61*	*2.90*	*8.44*
No Progress toward RBD	WK	−3	0.00	0.40	0.40
	OA	−3	0.00	0.39	0.39
	JA	−9	0.00	0.36	0.36
	EK	−22	0.00	91.03	91.03
	CS	−22	0.00	0.35	0.35
	NK	−36	0.00	0.30	0.30
	AM	−43	21.28	26.37	47.66
	CM	−45	0.00	0.36	0.36
	YU	−64	0.00	0.38	0.38
	AZ	−67	0.00	0.39	0.39
	MD	−83	0.00	0.20	0.20
	QR	−105	0.00	0.37	0.37
	PI	−128	0.00	0.39	0.39
	TB	−288	0.00	0.20	0.20
	WP	−560	0.00	0.34	0.34
	Total		*21.28*	*121.82*	*143.11*
	Mean		*1.42*	*8.12*	*9.54*
	Median		*0.00*	*0.37*	*0.37*
Grand total			*315.05*	*287.97*	*603.02*
Mean			*10.50*	*9.60*	*20.10*
Median			*0.00*	*0.39*	*0.39*

Progress toward the RBD target is expressed in terms of percent progress made toward achieving an 80% reduction relative to the baseline.

We call upon the Consumer Goods Forum (CGF) and other private sector initiatives … to partner with us as we build robust jurisdictional programs for REDD+ and low emissions development and to develop programs for preferential sourcing of agricultural commodities from GCF jurisdictions that demonstrate performance.

We are committed to making significant emissions reductions provided that adequate, sufficient, and long-term performance-based funding is available, whether through market or non-market sources. If guarantees of this financing are made, we commit to reducing deforestation by 80% by 2020."

Rio Branco Declaration (August 11, 2014)

This statement summarizes the types of assistance that RBD signatories believe are needed to effectively slow deforestation. It may also express frustration with delays in the implementation of California's tropical forest carbon market. The GCF TF was created in early 2009 to prepare tropical forest states and

provinces to participate in the international offset market of California's climate policy (Neto, 2015). Five years later, when the RBD was announced, this market had become highly uncertain. Today, over a decade later, it is still not implemented.

The RBD heralded the beginning of several pledges to reduce deforestation that states and provinces would make over the course of the next several years. However, it was the only one that was initiated by tropical forest governments and that made achievement of the deforestation goal dependent on international support. While cynics might identify such conditionality as a deficiency of voluntary commitments generally (Buhr et al., 2014), increasing the risk that pledges will not be implemented (den Elzen et al., 2011), more sympathetic observers might judge the request as a legitimate and justifiable expression of these governments' limited capacity to slow deforestation without assistance (Setzer, 2015; Libert-Amico and Larson, 2020).

An assessment of the RBD must address both dimensions of this pledge: (i) Were the conditions met? (ii) Did deforestation decline as promised? Overall, our findings indicate that the RBD may be judged a partial success. Although conditions were largely unmet, half of the 30 jurisdictions in our study have demonstrated progress toward reducing deforestation by 80%.

Response to RBD's Conditions
Condition 1: Adequate, Long-Term Performance-Based Funding
Funding to signatories was not considerably boosted following the announcement of the commitment, and RBF has been limited. Only one major bilateral donor responded directly to the RBD. This was Norway's USD 24 million pledge, announced within one year of the RBD and implemented three years later. To date, this funding has provided a maximum of USD 400,000 million per jurisdiction (USD 12 million to all signatories combined) in seed-funding to signatories, to support development of jurisdictional strategies and investment plans targeting deforestation reduction. Few, if any, other investments have materialized in response to the RBD. Brazilian jurisdictions have received the bulk of forest-related finance, both before and after the announcement of the RBD, much of it from the Amazon Fund, which accounts for 43% percent of all climate funds we identified (**Supplementary Table S4**).

Condition 2: Private Sector Partnership
The private sector's response to the call for partnerships was minimal (Stickler et al., 2018b). Just over one-third (11) of the study jurisdictions have established "declared" partnerships, in which a company has formally joined a declaration, coalition, or jurisdictional governance structure, but which has not yet resulted in formal preferential sourcing, financial investment, or technical assistance to the jurisdiction. These partnerships have been established through individual jurisdictional strategies, or consortia of multiple jurisdictions (Stickler et al., 2018b). Of those declared partnerships, only five have been "contracted," with a formal agreement defining the responsibilities and contributions of each party. These contracted partnerships are established in Acre, West Kalimantan, East Kalimantan, Mato Grosso (with individual counties), and Central Kalimantan (with individual

districts) (Stickler et al., 2018b). Meanwhile, as of February 2020, 484 companies – some of which are members of private sector initiatives such as CGF and Tropical Forest Alliance (Rothrock et al., 2020) – had made commitments related to sustainable sourcing of forest commodities. Of those, 72 have committed to zero or zero-net deforestation in their supply chains, indicating that there may be potential for substantially more partnerships with RBD signatories. However, of those 72, only 21 companies have reported quantitative progress on their commitment, demonstrating low transparency and a gap between pledges and implementation, increasing risk for investors (Rothrock et al., 2019).

Condition 3: Simple, Robust Performance Metrics
Progress on RBD signatories' demand for help in developing straightforward metrics to help access financing has also been delayed. "Zero Deforestation" (e.g., Amsterdam Declarations Partnership; the 484 corporate commitments mentioned above) is a prevalent performance metric for tropical forest regions (Rothrock et al., 2019), even though it is primarily feasible only within individual commodities' supply chains (Garrett et al., 2019). An important step forward in establishing a measure of success in addressing deforestation that is viable for jurisdictions was taken with the approval in September 2019 of the California Tropical Forest Standard. Jurisdictions that are verified against this standard could eventually sell forest carbon credits (California Air Resources Board (CARB), 2019).

Factors Influencing Jurisdictions' Progress
It is surprising that half of the jurisdictions made progress toward the deforestation reduction target, especially given the international community's modest response to the RBD's call for support. However, since each jurisdiction represents a complex system, simple declarations are not likely to be sufficient to make a voluntary pledge come to fruition. Below, we discuss possible explanations underlying individual jurisdictions' progress, or lack thereof, toward the RBD target.

RBD in Context
To begin to understand Brazilian jurisdictions' relative success vis-à-vis the RBD target, we consider the broader context in which the RBD was designed. Delegates to the UNFCCC's COP15 met in Copenhagen in 2009 to come to an agreement about how to reduce emissions after 2012, when the Kyoto Protocol would expire. After failing to negotiate a deal, the tropical forest conservation and climate mitigation community of practice looked to Brazil with enthusiasm as an example of the advances that could be made even without a formal international mechanism for rewarding deforestation reduction. By 2009, Brazil had already achieved a 64% reduction below the 10-year (1996–2005) average in its annual deforestation rate (in the Amazon forest region) (Nepstad et al., 2009; Soares-Filho et al., 2010), had initiated an ambitious national climate policy including a target to reduce deforestation in the Amazon by 80% (Federal Government of Brazil, 2008), and Amazon state governments were creating their own action plans

and targets for controlling deforestation (MMA, 2018) while negotiating independent roles in accessing resources to reduce deforestation (Nepstad et al., 2009). Five of these states were founding members of the GCF TF in 2009. In recognition of the declines Brazil had already achieved, Norway pledged USD 1 billion to Brazil's Amazon Fund in 2008 (Tollefson, 2009; **Supplementary Text S4**).

In the post-Copenhagen era, the community also turned increasingly to non-national actors as partners in achieving emissions reductions (Bäckstrand et al., 2017). As previously noted, a spate of commitments on the part of non-state and subnational state actors followed the Copenhagen negotiations breakdown. These ramped up dramatically just prior to the COP21 in Paris in 2015. In this environment, Brazil's achievements were seen as a symbol of what was possible with a combination of subnational, national, and non-state actors (Nepstad et al., 2014). The RBD target was modeled on the Brazilian national and subnational targets already in existence or under development at the time that the RBD was developed. Some Brazilian states were already close to achieving the target at the time of drafting.

Brazil

In 2004, as deforestation in the Amazon region was reaching its peak of 27,772 km^2 y^{-1} (PRODES (Projeto de Monitoramento do Desmatamento na Amazônia Legal por Satélite), 2019), the Brazilian government enacted the Plan for Prevention and Control of Deforestation in the Amazon (PPCDAm) (MMA, 2018). The policy targeted an 80% reduction in deforestation by 2020 and was critical in lowering deforestation and keeping it well below the peak level until recent years (Nepstad et al., 2014; Assunção et al., 2015). Its successful implementation was aided by robust law enforcement capacity, interventions in soy and beef supply chains, restrictions on credit access, expansion of protected areas, and declining demand for new land as landholders and subnational governments came to associate deforestation with higher risks of reduced access to markets and finance, fines, embargos and even prison sentences (Nepstad et al., 2014).

The PPCDAm recommended (but did not mandate) development of state-level deforestation prevention and control plans (PPCD) tailored to state-specific drivers and conditions. PPCDs were adopted by all nine Brazilian Amazon states (mostly between 2009 and 2012), and all but one (Rondônia) have a legal target originating from the PPCD. A PPCD is required for states to receive support from the Amazon Fund. Like the PPCDAm, the PPCDs generally focus on implementing the CAR and the Forest Code, strengthening enforcement capacity, expanding land titling, and preventing fire (Federal Government of Brazil, 2017). They do this, in part, by deliberately linking existing state laws and policies that address relevant issues but were disconnected.

Mato Grosso, Tocantins, and Maranhão are likely to achieve the RBD target by the end of 2020. Mato Grosso is one of the few study jurisdictions to fit the expectation that ambitious targets and more funding might be associated with greater progress. It demonstrates the second-highest level of progress toward the RBD and has received the second-highest value of funding pledges (USD 95.63 million), the majority of which comes from RBF through the REM program, albeit well after the state had already demonstrated dramatic reductions in deforestation (Nepstad et al., 2013). Mato Grosso deforested more than any other state in Brazil (with Pará and Rondônia close behind), or for that matter in the tropics, for over a decade through 2005. With a high percentage of medium to large individual landholdings and strong ties to international commodity markets and supply chains, Mato Grosso was most affected by and able to implement the combination of measures (both orchestrated and coincidental) that helped reduce deforestation in the Brazilian Amazon as a whole (Nepstad et al., 2014). Maranhão and Tocantins' performance is more surprising. Tocantins has a relatively small Amazon biome area (**Supplementary Table S2**); therefore, deforestation may be easier to control than in other states. The likelihood that Maranhão, Pará and Rondônia will reach the RBD target within a few years (2020, 2022, and 2025, respectively) is significant given their large forest areas and historically high deforestation rates.

In contrast, Acre – the only jurisdiction other than Mato Grosso to have received RBF directly and the jurisdiction which received by far the most funding pledges during the analysis period (USD 192.12 million) – made the least progress toward the target (29%) among the Brazilian states. Acre has long been considered a model of conservation-minded development – developing a political platform ("*Florestania*") that centers on forest conservation and support for sustainable livelihoods (Schmink et al., 2014) – and has shown important regional leadership (Burkhart et al., 2017). By several measures, Acre's jurisdictional low-emission development strategy may be considered a success (Stickler et al., 2018a): developing innovative governance mechanisms and initiatives (Schmink et al., 2014; Greenleaf, 2020), promoting sustainable forest product industries (Duchelle et al., 2011; Lopes et al., 2019), and engaging indigenous peoples and traditional communities in meaningful ways (DiGiano et al., 2020). However, Acre has also been actively pursuing road-paving to facilitate economic integration within the state and with Peru and the rest of Brazil (Soares-Filho et al., 2006); it also has a cattle-reliant economy (Soares-Filho et al., 2006; Hoelle, 2014). Both road-paving and cattle are known to directly increase deforestation (Soares-Filho et al., 2006, 2010).

Amazonas received the fifth-highest amount of funding pledges overall, with the funds fairly evenly divided pre- and post-RBD. However, it is the only Brazilian state to increase deforestation relative to the RBD baseline. For decades, its forests were protected by their distance from the deforestation frontier that was further south and east, in Pará, Mato Grosso, and Rondônia (Soares-Filho et al., 2006). Like Acre, Amazonas attracted early investments from private donors in recognition of its historical conservation of its forests and its simultaneous efforts to support its citizens via the innovative *Bolsa Floresta* (Bakkegaard and Wunder, 2014). However, Amazonas has seen the frontier move closer and deforestation increase, as the Trans-Amazon highway has become an increasingly important commercial link in the region (Walker et al., 2011).

Indonesia

Indonesia is among the world's top emitters of GHGs (Global Carbon Project, 2019), mainly due to conversion of its forests and carbon-rich peatlands to plantations, but also due to logging and mining (Austin et al., 2019). Fire, used mostly as a means of clearing land for agriculture, is another major contributor to deforestation (Fanin and van der Werf, 2017). These drivers have reduced primary forests by 60,200 km^2 (6.1%) from 2000 to 2012, mostly on the islands of Kalimantan and Sumatra, leaving 49% of the country's territory under primary forests (Margono et al., 2014). In the Kalimantan provinces, deforestation increased in 2015 and 2016, apparently due largely to a high incidence of forest fires resulting from abnormally dry conditions related to the El Niño event of that period (Field et al., 2016; Fanin and van der Werf, 2017; Austin et al., 2019).

In 2009, Indonesia pledged to reduce its GHG emissions by 26% by 2020, or by 41% with international support (Indonesia's 2016 NDC extended the timeline to 2030, but increased the unassisted commitment to 29%) (Indonesian Redd+ Task Force, 2012). The NDC pledge includes a deforestation-specific target (Republic of Indonesia (ROI), 2016). In 2010, Norway and Indonesia established the Indonesia-Norway REDD+ Partnership (Indonesia-Norway LOI), under which Norway committed USD 1 billion to Indonesia to support deforestation reduction efforts specifically, with a USD 100 million payment up front and the remainder conditional on performance (Government of the Kingdom of Norway (GON), and Government of the Republic of Indonesia (GOI), 2010), similar to Norway's contribution to Brazil's Amazon Fund. Deforestation continued to increase for several years after these commitments were made (Global Forest Watch (GFW), n.d.), but declined sufficiently in 2017 that Norway announced in 2019 that it would make its first results-based payment (Norway in Indonesia: Royal Norwegian Embassy in Jakarta, 2019). Multiple factors contributed to the 60% decline in Indonesian deforestation in 2017 compared to 2016, including lower forest fire incidence due to favorable weather conditions (Ruiz and Putraditama, 2019), declining palm oil prices disincentivizing expansion (Austin et al., 2017), new policies (notably, a moratorium on new clearing of primary forests and peatlands) (Austin et al., 2014), and improved enforcement (Mongabay Haze Beat, 2016; Seymour, 2019).

In the late 1990s, Indonesia initiated a decentralization process to transfer authority over natural resource management from the central government to subnational units (Indrarto et al., 2012). Under Local Government Law 23/2014, the central government regained authority over state forests, including management, monitoring, and licensing [Republic of Indonesia (ROI), 2014]. Provinces were delegated power over forest management, whereas districts (the level below provinces) were delegated power over location permits, the first step required for establishing a plantation, and permits to clear land (Steni, 2016). In essence, provinces acquired authority over forest protection and management, but not over the drivers of deforestation (Setiawan et al., 2016). Contradicting laws, regulations and

priorities at national, provincial and local levels likely complicate and create inconsistencies in addressing deforestation at the provincial level (Setiawan et al., 2016). Whereas four provinces have deforestation reduction targets in their Provincial REDD+ Strategy and Action Plan (SRAP), only one is measurable and time-bound (West Kalimantan). SRAP development is not coordinated with national or district level processes, reflecting the weak multi-level coordination that creates challenges for REDD+ governance in Indonesia (Ekawati et al., 2019). These general circumstances likely help to explain why we could not observe a clear correspondence between the existence of legal targets and progress toward the RBD goal among Indonesian provinces.

Only three of Indonesia's signatories have made progress toward the target – Aceh, Central Kalimantan, and Papua; Papua is one of four study jurisdictions overall that is likely to meet the target by 2020. None of these three received any direct funding pledges prior to 2015 (although they were implicitly included in the Indonesia-Norway LOI). Aceh and Central Kalimantan received the second- and third-highest pledged finance, respectively, among the Indonesian jurisdictions, whereas Papua received only UNDP-Norway finance. Papua has not received the attention that Central, East, and West Kalimantan have received for their forest clearing, but official Indonesian Ministry of Forestry data indicate that approximately 12,000 km^2 were cleared in Papua between 1990 (or earlier) and 2000 (**Supplementary Text S1**), likely due to logging (illegal and legal), mining, and shifting agriculture (Hidayat and Yamamoto, 2014). Together with high deforestation from 2004 to 2006, this extensive clearing led Papua to have among the nine highest RBD baselines of all the study jurisdictions, in the same range as West Kalimantan, East Kalimantan, Amazonas (Brazil), and Maranhão. However, because of Papua's high remaining forest cover (248,332 km^2; 79% of the province), and because the clearing has not (yet) been primarily associated with a high-profile commodity like oil palm, it seems not yet to have garnered particularly great international interest on the part of donors focused on reducing deforestation. However, this is changing as oil palm plantations increasingly replace forests in the province (Austin et al., 2017).

We would expect Central Kalimantan's progress toward the RBD target (12% achieved) to be of greater interest to donors and companies, given the province's consistently high deforestation rates (Carlson et al., 2013; Setiawan et al., 2016), and its pledges to achieve zero-deforestation oil palm plantations and an 80% reduction in deforestation province-wide by 2020 (Plantation Office of Central Kalimantan (POCK), 2013). Deforestation reached a peak of nearly 1,900 km^2 in 2015, but has since declined to approximately 1,400 km^2 annually over the last three years, on par with Rondônia and Mato Grosso (**Supplementary Figure S1** and **Supplementary Table S5**). To date, the province has only received USD 2.34 million in pledges for its deforestation reduction efforts specifically. Central Kalimantan was designated as Indonesia's official REDD+ pilot province in 2010, following the Indonesia-Norway LOI (Dohong, 2011); however, we were unable to determine what portion of the initial USD 100 million payment was received by Central Kalimantan.

West Papua demonstrated the largest percent increase in deforestation relative to its baseline compared with all other study jurisdictions, with minimal deforestation until 2012 (averaging 16 km^2 annually from 2001 to 2011), reaching a high of 313 km^2 in 2017 (**Supplementary Figure S1 and Supplementary Table S5**). Increasing industrialization, infrastructure development, extractive industries (oil and logging), and commodities expansion have increased pressure on its forests in recent years (Indrawan et al., 2019; Sloan et al., 2019). The province faces a serious challenge to achieve an 80% reduction in deforestation below its already low baseline (38 km^2), to below 8 km^2 annually, and does not have a measurable legal target defined in its SRAP (Provincial Government of West Papua (PGWP), 2012). The governor declared West Papua a "Conservation Province" in 2015, but progress implementing this concept has been slow (Mulia, 2018), possibly impeding progress toward the RBD target.

Mexico

Mexico has a complex deforestation and forest degradation history (Bray and Klepeis, 2005; García-Barrios et al., 2009). Despite having already lost more than half of its original forests (including at least 90% of tropical rainforests and 70% of tropical dry forests) (García-Barrios et al., 2009), Mexico continues to lose forests at a high rate (Aide et al., 2013). The principal driver of deforestation in the country's tropical forest regions is pasture expansion (Bonilla-Moheno and Aide, 2020), alongside small-scale agriculture and fuelwood harvesting (in the highlands) (García-Barrios et al., 2009). Even as urban populations grow, a strong remittance economy allows rural populations to remain and expand pasture and croplands into forests, preventing forest regeneration (García-Barrios et al., 2009). Mexico's forest regions tend to be more densely populated than Brazil's or Peru's (Food and Agriculture Organization of the United Nations (FAO), 2004); thus, many remaining forests are highly accessible and vulnerable.

The government has enacted policies and programs to address this persistent and pervasive deforestation, largely linked to participation in international REDD+ processes (Ellis et al., 2017). Mexico was among the first tropical nations to voluntarily commit to climate mitigation actions within the context of the United Nations' REDD+ program, in 2010 (National Forestry Commission (CONAFOR), 2017), and also signed the Bonn Challenge, pledging to restore 7.24 million hectares of forest nationwide. Four Mexican GCF TF states defined their own Bonn Challenge targets, both in terms of their contributions to the national target and additional state-level restoration targets. The National REDD+ Strategy (ENAREDD+, implemented 2017) sets Mexico's goal of net zero deforestation by 2030. It builds on targets previously established in Mexico's General Law on Climate Change (2012) – to reduce emissions 30% by 2020 and 50% by 2050, relative to 2000 emissions, across all sectors – and on Mexico's NDC target to reduce emissions 22% by 2030 (Government of Mexico (GOM), 2016; National Forestry Commission (CONAFOR), 2017). The Emissions Reduction Initiative (IRE) [funded by the Forest Carbon Partnership Facility (FCPF)] largely reflects Mexico's jurisdictional approach to REDD+, although it is managed at the national level (Forest Carbon Partnership Facility (FCPF), 2017). The IRE functions by developing Investment Programs within Mexico's "Early Action REDD+" states (Campeche, Chiapas, Jalisco, Quintana Roo, and Yucatán), which establish specific activities to address local deforestation drivers. All legal targets for Mexican states come from their respective State REDD+ Strategies (EEREDD+), which are guided by and aligned with the ENAREDD+ approach. Tabasco is the only Mexican state with no published EEREDD+, or a legal target, and it has also increased its deforestation the most out of all Mexican states with respect to its baseline.

Mexican states are addressing their specific deforestation drivers through their EEREDD+ and other state-level initiatives. Jalisco, Quintana Roo, and Yucatán have implemented inter-municipal governance models, which promote coordination between state and municipal levels – also coordinating with the national level – in order to more effectively address drivers of deforestation within states (David et al., 2018b; Rodriguez-Ward and David, 2018a,b). Mexico is a federal republic, with political decentralization outlined in its constitution (Government of Mexico (GOM), 2019); however, "centralist tendencies" persist in practice (Trench et al., 2018; Libert-Amico and Larson, 2020). These limitations to subnational power include national control of natural resources (Libert-Amico and Larson, 2020); this is reflected in Mexico's REDD+ policy framework, which is managed by the National Forestry Commission (CONAFOR). Thus, although Mexico's relevant national policies – ENAREDD+ and IRE – employ a jurisdictional approach, it may be that states do not have as much agency in terms of implementation of these initiatives as would be expected on paper. Decisions related to land use change are generally political, often reflecting dominant economic models that may compete with low-emission development (e.g., agriculture, mining) (Trench et al., 2018).

In Jalisco, for example, agricultural interests compete with efforts to reduce deforestation. Jalisco's EEREDD+ specifies inter-institutional coordination (e.g., with the agricultural sector), including cooperation agreements to promote sustainable development, as part of the state's strategy for reducing deforestation (Secretary of Environment and Territorial Development of the State of Jalisco (SEMADET), 2017). While such agreements have been developed and implemented – for example, the use of silvopastoral systems as a deforestation reduction strategy (Cinco-Martínez et al., 2018; David et al., 2018b) – these measures may not be sufficient to drive meaningful reductions in deforestation, or be able to adequately control leakage.

In Chiapas, the Mexican state with the highest accumulated deforestation from 2001 to 2015, most emissions stem from expansion of the agricultural frontier, largely related to the lack of regulation of the beef and palm oil sectors and the impact of the coffee industry (Jurjonas et al., 2016; David et al., 2018a). Chiapas' efforts to address deforestation have been limited by low multi-sectoral coordination and continued interest of the national and state governments in investing in Chiapas' cattle ranching and agriculture sectors, which diverts financial resources away from

environmental programs (David et al., 2018a). These competing interests to conservation in both Jalisco and Chiapas may also contribute to the low interest of international donors and investors in the jurisdictions.

Peru

With the world's fourth largest tropical forest estate and low historical deforestation, Peru's expanding forest clearing is a major climate concern. Expanding small-scale agriculture (including illegal crop cultivation), mining (small- and large-scale), cattle ranching, and logging, (mostly selective and illegal) have been the principal causes of forest clearing and degradation since at least the early 2000s (Asner et al., 2010; Robiglio et al., 2014; MINAM, 2016), reducing tree cover by 1.65 million ha by 2014 and leaving 56% of the country's territory under natural forests (MINAM, 2016). More recent economic growth has compounded these threats with new ones stemming from the expansion of commodity crops such as oil palm, extractive industries including mining, and road building (Gutiérrez-Vélez et al., 2011; Robiglio et al., 2014).

National policies to address deforestation were developed in response to increasing international interest in REDD+. The national Ministry of the Environment (MINAM) was created shortly before Peru announced its official involvement in REDD+ in 2008, and remains responsible for monitoring and evaluating REDD+. In 2011, the national government announced its ambition to eliminate clearing of primary forests by 2021 (Ministry of the Environment (MINAM), 2011). In 2014, Peru hosted the UNFCCC COP20, further cementing its commitment to reducing deforestation.

Peru's RBD signatories (with the exception of Piura, where forests historically covered only 2.3% of state, now reduced to 1.6%) have high forest cover and historically low deforestation rates. In recognition of likely further deforestation, the national government projected the forest reference level as a linear increase of the average annual deforestation rate between 2000 and 2014. San Martín, Loreto, Huánuco and Ucayali had the highest annual deforestation rates of all Peruvian study jurisdictions during the reference period, but all four showed declining rates after 2014 (**Supplementary Figure S1** and **Supplementary Table S5**). San Martín reached a high of 393 km^2 in 2009, and currently averages around 200 km^2 annually. In contrast, Amazonas and Madre de Dios maintained very low deforestation rates throughout the reference period (42 km^2 and 91 km^2, respectively), but have begun clearing far more than this average since 2014. Madre de Dios has increased its deforestation rate more than fourfold since 2000, due largely to a burgeoning mining sector (Caballero Espejo et al., 2018).

As in other countries, we did not observe a clear correspondence between the existence of jurisdictional legal targets and progress toward the RBD goal. The only region without a legal target is Huánuco (**Table 5**), which has made the second most progress toward the RBD target among the Peruvian regions. San Martín has made the most progress and received the most finance in Peru (76%), and is the only Peruvian region to have received any finance pre-RBD (**Table 7**). This high pre-RBD funding reflects our observation that jurisdictions that

have made greater progress in reducing deforestation tend to have seen an earlier input of funds.

An ongoing decentralization process in Peru, which started almost two decades ago, continues to influence strategic development and environmental planning. The passage of the Organic Law of Regional Governments in 2002 precipitated coordinated environmental planning at the regional level by mandating Concerted Regional Development Plans (PDRC). PDRC are the main regional planning documents; three Peruvian regions' legal deforestation targets come from their respective PDRC. Others come from Regional Environmental Action Plans (PRAA) and Strategic Institutional Plans (PEI). While the National Center for Strategic Planning advises alignment of PDRC with the National Development Plan (PEDN), there is no integrated territorial vision or strategy, and there are no clear requirements for PDRC to conform with the PEDN or to contain quantitative, time-bound targets (OECD, 2016; Fernández-Maldonado, 2019). Additionally, support is lacking from the national level for setting ambitious targets in the PDRC; technical capacities vary widely between Regional Governments, and no clear incentives or measures exist to improve capabilities or plans (OECD, 2016; Rodriguez-Ward et al., 2018). The national government maintains tight control of regional budgets, and often has failed to allocate the financial resources necessary for them to fully take on their devolved responsibilities regarding land-use planning and forest management (Kowler et al., 2016; Rodriguez-Ward et al., 2018; Libert-Amico and Larson, 2020).

Emergent Issues, Challenges, and Future Directions

Several considerations arise from our examination of factors possibly explaining jurisdictions' progress (or lack thereof) toward the target. As noted earlier, the RBD deforestation reduction target was modeled on Brazilian national- and jurisdictional-level targets. For many other signatories, especially those that signed later, however, this goal may have been over-ambitious and difficult, if not impossible, to attain given that they had not already initiated concerted deforestation reduction efforts. Our review of some of the potential explanations for jurisdictions' progress toward the RBD also highlights issues like degree of decentralization and support from the national level (Wright et al., 2016; Libert-Amico and Larson, 2020), capacity for implementing the necessary actions to reduce deforestation (which are linked to funding and policy frameworks) (Wright et al., 2016; Libert-Amico and Larson, 2020), political and administrative turnover (Libert-Amico and Larson, 2020), and stage in frontier expansion process (Rudel et al., 2005; Barbier et al., 2010).

The Role of Finance in Achieving Voluntary Commitments

Resources to support jurisdictions in achieving their RBD target have been small in volume and slow to arrive, much like climate finance more generally (Seymour and Busch, 2016). As noted earlier, the UNDP-Norway pledge was the only direct response to the RBD's call for assistance from the international community. Norway's initial contribution to jurisdictions was

financial support to develop low-emission development strategies and investment plans which, given the delay in disbursement, means that these strategies will only be completed after 2020. In the time between pledge and disbursement, most RBD signatories experienced political turnover (Stickler et al., 2018b); in many cases, the governors who signed the RBD were no longer in office when this funding arrived. In some cases, new administrations' priorities did not align with the deforestation reduction agenda or they lacked capacity to implement such an agenda. Although the motive for political leaders to sign the RBD was likely the prospect of finance, investment, or corporate partnerships for their jurisdictions, none of these benefits were delivered in a time period or at a scale that represented a significant positive response to the signatory.

Information on the timing and destination of climate finance disbursements to RBD signatories was difficult to find (**Supplementary Text S4**). We did not inventory the volume of domestic resources (national or subnational budgets) that were allocated for actions to reduce deforestation. We also did not attempt to account for how recipient jurisdictions spent funds that they may have received. These represent important areas of future research to help understand more clearly why some jurisdictions may not be able to fulfill commitments such as the RBD.

With the rapid growth of company commitments to climate neutrality and buying offsets to achieve those commitments (Nepstad, 2019), the speed and simplicity of financial flows to jurisdictions that are lowering emissions from deforestation could increase significantly. Here, too, the impact of this trend on tropical forest jurisdictions will vary greatly between countries, given differences in autonomy of subnational governments to engage in carbon transactions with the private sector.

The Role of the Policy Framework in Achieving Voluntary Commitments

We expected that jurisdictions that formalized their RBD pledge within their legal and policy frameworks would be more likely to fulfill the voluntary commitment. This expectation was based on the argument that domestic legislation ("hard" law) in support of voluntary commitments ("soft" law) opens access to new tools and resources, mobilizes additional actors, and creates stronger incentives for compliance – in other words, creating the necessary conditions for success (Schaffer and Pollack, 2010). While originating in debates around compliance with international law (Schaffer and Pollack, 2010; Brown Weiss, 2014), our research indicates that for many subnational jurisdictions, jurisdiction-level regulations and policies are fundamental for unlocking budget and other support at both subnational and national levels.

In this study, we only explored evidence for the significance of legal targets in terms of alignment with the RBD target. An important area for further research into the policy conditions that favor achievement of voluntary commitments is the type, quality, implementation, and impact of interventions created to protect forests or encourage stakeholders to engage in sustainable practices. An earlier analysis indicates that while some RBD signatories have jurisdiction-wide low-emission development strategies in place, very few included strong policies and

incentives within those strategies or linked specific deforestation reduction initiatives to existing policies across sectors (Stickler et al., 2018b). Furthermore, policy interventions associated with deforestation reduction and sustainable land-use tended to be isolated and/or narrow in scope.

Although our analysis demonstrates that most signatories are unlikely to achieve the RBD target by 2020, it does not rule out the possibility that jurisdictions made more progress than they might have without the commitment. An important future avenue of research would explore in more detail existing policies and initiatives across sectors (including those driving deforestation) and their interactions, as well as actual expenditures for actions emanating from them. Beyond the existence of legal targets commensurate with the RBD target in jurisdictions' legal and policy frameworks, there are many other considerations related to how policy contexts influence progress toward the RBD target. These may include the way in which a jurisdiction's spatial planning considers (or fails to consider) the target, the strength of monitoring systems to track progress and therefore be able to adjust strategies as necessary, and the relative ease of engaging with and incentivizing the population groups and industries whose actions constitute a key component of meeting the target (Stickler et al., 2018b).

It would also be important to further research the enforcement capacities of subnational governments in terms of the policies in place that may contribute to reducing deforestation. The degree of subnational authority to address drivers of deforestation varies across countries and sectors (Busch and Amarjargal, 2020; Libert-Amico and Larson, 2020). Greater decentralization, in theory, would increase subnational authority; however, *de jure* decentralization does not inherently equate to meaningful powers *de facto* (Ribot et al., 2006; Libert-Amico and Larson, 2020). The degree and type of decentralization (e.g., political versus administrative decentralization; see Ribot, 2002) can influence subnational governments' ability to enact and achieve legal targets that may contribute to meeting the RBD commitment.

The Role of Baselines in Evaluating Progress Toward Commitments

For all of the study jurisdictions, baselines are developed at the national level and reflect national deforestation trends. Mirroring the debate concerning REDD+ baselines at the international level (Huettner et al., 2009; Chiroleu-Assouline et al., 2018), this approach places jurisdictions that have historically conserved much of their forests and are now clearing more (e.g., West Papua, Madre de Dios) at a disadvantage, and benefits those that have historically deforested greater amounts and are now making reductions (e.g., Papua, Mato Grosso). Mato Grosso, for example, has cleared an average of 1,513 km^2 y^{-1} in the last three years (**Supplementary Table S5**); because this is far below the state FREL of 5,917 km^2 y^{-1}, the state is one of the RBD's principal success stories. West Papua, on the other hand, appears as an RBD "failure" due to a 724% increase in deforestation relative to its baseline, despite clearing in the range of 18 to 313 km^2 y^{-1} in the five years since the end of the baseline period. Mato Grosso's achievement is extremely important, as it has historically been one of the tropics' major

deforesters. However, we argue that it would be important to tailor targets and the baselines they use to recognize jurisdictions' different histories, such that they are ambitious but realistic. This is akin to the approach taken both with the NDCs under the Paris Agreement and the U2MOU, and would allow donors and investors to better support jurisdictions in different stages and circumstances.

Significance of Results for Other Voluntary Commitments

The NYDF set out to halve deforestation by 2020, and eventually reach zero deforestation by 2030. Seventeen of the study jurisdictions also signed the NYDF, but these do not include Brazil's historically highest deforesting states (Mato Grosso, Pará, Rondônia) (Stickler et al., 2018b). Of those that signed the NYDF, eight are reducing deforestation relative to the reference level we derived from national FREL submissions; the baseline for NYDF was not specified, but NYDF Assessment Partners used the 2001 to 2013 time period in their initial assessment of national progress on the goal (NYDF Assessment Partners, 2019). We have not calculated the extent of progress toward either the NYDF milestone or target, as it is beyond the scope of this study. However, it is notable that jurisdictions with the highest deforestation rates and volumes (with the exception of Central Kalimantan and West Kalimantan) (**Supplementary Table S5**) did not sign the NYDF (though Indonesia, Mexico, and Peru all signed separately, at the country level) (New York Declaration on Forests, 2014). Twenty-three of the study jurisdictions also signed the U2MOU, which commits signatories to reducing overall emissions by 80-95% below 1990 levels by 2050; individual commitments related specifically to reducing forest loss vary based on signatories' existing legal targets. Of those jurisdictions that signed both, we found that 10 are making progress in reducing deforestation below the FREL. These include Brazil's major deforesters. However, as jurisdictions' strategies for meeting the U2MOU commitment vary, and are often inconsistent with both the RBD and U2MOU targets, we cannot say what our results imply for potential achievement of the U2MOU.

Achieving the RBD target conceivably had the potential to make substantial contributions to reaching signatories' respective NDC goals. However, under current deforestation trajectories, this is only still possible for Brazilian jurisdictions. Brazil faces a new political reality that is credited with leading to increased deforestation and forest degradation (Abessa et al., 2019), thus the level of progress by Brazilian RBD signatories is not a foregone conclusion. Assuming that Mato Grosso, Rondônia, and Pará maintain the current rates, they will account for nearly all of Brazilian Amazon states' contribution to the NDC. Furthermore, under the current deforestation trajectory scenario, Brazilian states would be responsible for almost all of the RBD signatories' contribution (approximately 0.65 $GtCO_2e$ y^{-1}, or 3.7%) to the reduction in emissions called for by the Intergovernmental Panel on Climate Change (IPCC) to keep global warming to 1.5°C or lower [IPCC (Intergovernmental Panel on Climate Change), 2018].

CONCLUSION

Progress in slowing tropical deforestation generally has been slow, despite the increase in finance and corporate engagement around this issue over the last decade. Building the political will and institutional capacity to lower deforestation rates requires major effort over a sustained period of time. Perhaps the principal reason that the story of the RBD is largely one of Brazilian states is that the Brazilian Amazon has for decades been the focus of intense domestic and international pressure that has sometimes compelled the national government and, increasingly, individual jurisdictions to find effective ways to lower deforestation rates. Only Indonesia comes close to receiving similar attention internationally, albeit more recently.

Voluntary non-binding commitments are growing in prevalence among the set of instruments used to reduce deforestation. They can help start a dialogue with a broader community of interested parties, much as the RBD has done. Signatories established clearly in the RBD itself the types of support they require in order to achieve a goal of great interest to a range of local and international stakeholders. The response to this call for help was limited: only one bilateral donor responded with a financial pledge, very few companies responded with partnerships, and the broader community has not provided simple and robust metrics. Regardless, half of signatories we investigated are reducing deforestation below their baselines.

Faster and larger responses on behalf of the international community to calls for help from the governments of tropical forest jurisdictions could potentially contribute significantly to greater success in slowing deforestation in the coming years. However, this will likely require financing and other support beyond that which bilateral, multilateral, and other donors are able to deliver as a result of their current priorities and restrictions. And increasingly, private sector actors – including those with zero-deforestation commitments and those with more general emissions-reduction goals – will also need to collaborate with governments and other stakeholders to help provide the necessary support in order to achieve collective climate goals.

DATA AVAILABILITY STATEMENT

All datasets generated for this study are included in the article/**Supplementary Material**.

AUTHOR CONTRIBUTIONS

CS led design and implementation of the study. CS, OD, and CC wrote the text of the manuscript. OD, JA, and CC led data collection and analysis with respect to deforestation targets. JA led data collection and analysis of subnational reference levels and deforestation and emissions scenarios. OD and TB compiled data on international finance. OD and CS analyzed

those data. All authors contributed to the article and approved the submitted version.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/ffgc.2020.00050/full#supplementary-material

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