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Deforestation and timber production in Congo after implementation of sustainable management policy: A response to Karsenty et al. (2017)

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ABSTRACT

The outcomes of forest management (FM) as implemented by industrial logging corporations in tropical forests is an issue that merits greater scrutiny than it has received thus far. We, therefore, welcome the contribution by Karsenty et al. (2017) that questions some of the findings advanced in our article (Brandt et al., 2016). Our paper used satellite-derived deforestation data and statistical matching techniques to examine patterns of deforestation and timber production in the Republic of Congo after the implementation of FM plans in timber concessions. We found that a) deforestation rates were higher in concessions that had a registered forest management plan (FMP) compared to those that did not ; b) deforestation rates increased after a concession adopted a FMP; and c) timber production was higher and more stable in concessions that adopted a FMP than in concessions that did not. In their response, Karsenty et al. (2017) question our analytical approach and advocate for different evaluative criteria. While their response offers new and potentially valuable perspectives, it also criticizes our paper for errors our paper does not contain, and suggests we should have carried out analyses that we already did. In this rejoinder, we discuss the extent to which we consider their arguments relevant, valid, and worthy of further study. We note that neither Karsenty et al. (2017), nor any other peer-reviewed article that we know of, provide empirical results that contradict the findings of our original article.

1. Introduction

Sustainable Forest Management (SFM) arose in the 1990's in direct response to alarming rates of tropical deforestation. More than 183 million hectares of tropical forests worldwide are reported to be managed under SFM principles (Blaser et al., 2011). Tropical deforestation occurs because in most tropical regions, maintaining and managing forest is not the most profitable land use. Thus, forests are cleared for timber, paper pulp, etc., and then replaced by agricultural crops or other more profitable land uses (Nasi and Frost, 2009). The goal of SFM is to retain forests on the land by allowing timber to be harvested more profitably, and in a manner that does not deplete the timber resource in the future (Putz et al., 2012). Forest Management Plans (FMPs) are and have been the standard tool for regulating timber extraction rates. They specify when and where trees can be harvested to achieve sustainable harvest rates, for example, by limiting the annual allowable cut, the maximum volume of wood per area that can be harvested per year, and the minimum size of trees that can be harvested (Cerutti et al., 2008). FMPs are used as an indicator that a logging operation is complying with SFM policy (FAO and ITTO, 2011; Putz et al., 2012).

In our original article (Brandt et al., 2016) we examined patterns of deforestation and timber production in concessions with and without FMPs in the Republic of Congo using statistical methods commonly applied in counterfactual policy impact analysis. We have conducted counterfactual impact analyses of forest policies in various study regions around the world (Brandt et al., 2017; Brandt et al., 2015; Brandt et al., 2014; Nolte et al., 2013; Nolte et al., 2017). Our approach is inspired by a rich and growing literature (Andam et al., 2008; Blackman et al., 2017; Chervier and Costedoat, 2017). Specifically, we relied on statistical matching, which compares parcels that are similar in their observable characteristics related to deforestation pressure but are located in concessions with different management regimes. Many scholars have used matching-based strategies to assess protected area effectiveness (Ferraro et al., 2015; Nolte et al., 2013; Robalino et al., 2015), community forest management outcomes (Brandt et al., 2015; Rasolofoson et al., 2015), results of land use zoning (Bruggeman et al., 2015), and effects of certification policies (Miteva et al., 2015). To complement the matching approach, we conducted a simple before and after analysis comparing deforestation rates and timber production in a single concession during the years before and after the FMP was

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implemented.

In their response, Karsenty et al. (2017) question our analytical approach, and thereby our findings. Some of their insights are potentially valuable and point towards the need for better and more comprehensive analyses. However, much of their critique is not founded in rigorous evidence, and some of it either ignores or misreads the key arguments of our paper. In this rejoinder, we address their criticisms and contextualize them in relation to standard practices for using remotely sensed data and statistical matching techniques.

2. A detailed response to the critique of our analysis

2.1. Geographic scope

Karsenty et al. (2017) claim that the geographic scope of our study, *i.e.* the entire country, is inappropriate because the northern and southern parts of Congo are different. However, it is common for impact analysts to include an entire country (Andam et al., 2008; Ferraro et al., 2011; Ferraro et al., 2013; Joppa and Pfaff, 2010), multiple countries (Brandt et al., 2017), or an entire continent (Bowker et al., 2017; Nelson and Chomitz, 2011) when conducting counterfactual analysis. There are important theoretical and decision-making related arguments for focusing on an entire country. The matching procedure takes into account observable regional differences in identifying appropriate control units for estimating the effect of the treatment. When it comes to matching based-analyses, the issue is less whether a district, province, or country are the appropriate analytical categories, and more whether key differences in the characteristics of treatment and control units have been controlled for by selecting and balancing the relevant covariates. Indeed, the benefit of country-level impact analyses is that they can lead to findings relevant to policy making for the country as a whole, rather than for regions such as the north and the south where no relevant decision-making units are located.

2.2. Parcel selection

Karsenty et al. (2017) question some of our choices with regards to parcel selection. Our process for parcel selection was systematic, well-justified, and fully transparent. Our concessionary management designations were selected from the Forest Atlas of Congo, the most consistently-collected, publicly available, official source of industrial logging information for the entire country (WRI and MDDEFE, 2012). Standard protocol for broad-scale policy-impact analyses require the use of data collected as uniformly as possible in a given study domain. Such a procedure ensures the transparency and consistency of the analysis. In this context, Karsenty et al. (2017) claim that one of the concessions included in our analysis was a conservation concession. While this is a potentially relevant insight, it is difficult to evaluate its broader implications in the absence of more comprehensive data. The Forest Atlas of Congo does not include conservation concessions as an official designation which means that this category cannot be applied uniformly across the concessions in the Republic of Congo. Nor do Karsenty et al. define what a conservation concession is or provide the years of the purported designation. It is unclear whether such information has been collected and is available for all concessions in the country. The role of conservation concessions in inhibiting deforestation and influencing our findings is a certainly a subject worthy for further study, but will require more comprehensive information than that supplied by Karsenty et al. (2017).

2.3. Date of policy implementation

Karsenty et al. (2017) critique how we assigned the date of policy implementation in our analysis. Their key point is that actual implementation of policies may well vary from official dates and it is part of their larger argument about the need to be attentive to contextual details and on-the-ground information. Their larger point is well taken, but the specific critique they advance does not undermine our analytical approach. Indeed, it possibly lends greater strength to our findings. We used the official date of FMP implementation included in the Forest Atlas of Congo. This approach is similar to those commonly used in counterfactual impact analyses of protected areas, in which implementation dates are assigned based on the World Database of Protected Areas (WDPA), an official, open-source repository of information on global protected areas. Protected areas and logging concessions are similar in that there may be variation in terms of actual versus official dates of implementation, or there may be variations in management among PAs of the same category. These details are not included in official databases and it is rarely feasible to collect consistent detailed data for all units across broad spatial scales. What is more, the existence of such variation typically introduces noise in the timing of the treatment variable (FMP implementation) and thereby increases the inefficiency of the estimation. The fact that our analysis nonetheless finds clear impacts of SFM designation likely implies that the statistical significance of the FMP impacts we identified is higher than revealed by our noisy measure.

2.4. Outcomes

Karsenty et al. (2017) have two major critiques with regards to outcomes used in our analysis. First, they state that we used a national-level roads dataset as an outcome. This is not true. Roads were not used as an outcome in the empirical analysis, and this was clearly stated in our Methods section. In Figure 1 of our original article, we included a small section of the national roads dataset to provide a visual representation of how deforestation patterns correspond to logging roads. This may have led to their misinterpretation.

Their second critique, based on an article from 2008 (Duveiller et al., 2008), is that satellite-derived deforestation data is inappropriate in our study area because of cloud cover. In the past decade, remote sensing scientists have made major advances for dealing with cloud cover in satellite data. The datasets used in our analysis (Hansen et al., 2013; OSFAC, 2010; Potapov et al., 2012) used an image compositing approach, which compiles dense Landsat time-series to create cloud-free images. Deforestation data derived from satellite imagery is ubiquitously used as an outcome of environmental policy, including in the tropics. Unlike other potential outcomes (*e.g.* species richness), it can be measured consistently over large areas. Especially in the Congo, deforestation is directly relevant to any efforts at impact evaluation of SFM and FMPs because one of their most important goals is to limit forest clearing (FAO and ITTO, 2011). Like many broad-scale policy impact studies, we used deforestation as our indicator of conservation outcomes (DeFries et al., 2010; Hansen et al., 2013; Nolte et al., 2013). Our deforestation datasets only measure forest clearing, but not forest regeneration, road persistence, or wildlife communities, which are also important outcomes to consider when evaluating the strengths and weaknesses of current SFM policy in tropical forests.

2.5. Covariates

In terms of covariates used in our analysis, Karsenty et al. (2017) make several incorrect claims. For instance, they state that we did not consider population density. However, as described in detail in our Methods, we used distance to the nearest settlement in the year 2005 as the best available proxy for population density. Reliable census data covering the entire country does not exist. In such study areas as the Congo, proximity to a settlement is frequently used as a proxy because it represents accessibility and the intensity of human forest use (Andam et al., 2008; Mayaux et al., 2013; Mertens and Lambin, 1997). Karsenty et al. (2017) further assert that neither National Road 2 nor the city of Ouesso are considered in our covariate dataset. Again, this is incorrect. Both were incorporated in the Travel Time calculation. National Road 2 was included as a major highway, and the city of Ouesso was included as a major market. Finally, Karsenty et al. (2017) misrepresent how we dealt with areas of extremely high deforestation close to the Congo/Oubangi River. As described in our original article, the deforestation data demonstrated a clear threshold with regards to the Congo/Oubangi River: within 15 kms of the river, deforestation was extremely high, and greater than 15 km from the river, deforestation levels were comparable with the rest of the country. Accounting for such dramatic differences is critical because policies may have different effectiveness depending on the level of deforestation pressure (Nolte et al., 2013). Thus, in our matching procedure, we specified that when a treatment parcel (*e.g.* a FMP parcel) was within 15 km from the river, a "matched" control parcel (*e.g.* no-FMP) must also be within 15 km of the river, to ensure an "apples-to-apples" comparison. With this approach, theoretically, we could test how FMP and no-FMP management regimes compared in areas of extremely high deforestation pressure. However, in reality, there were no FMP concessions located near the river (likely related to placement bias, *i.e.* forests near the river may be degraded, or there may be major challenges with enforcement in such a high-use area). Thus, the comparison of management regimes in the band of high deforestation near the river was not possible. As such, our analysis compared management regimes in regions not within 15 km of the Congo/Oubangi River, which is > 98% of the total concessionary area of the country.

3. Their (naïve) analysis, placed in context of standard practices in counterfactual policy impact analysis

Karsenty et al. (2017) present an analysis in which they consider an alternative research question: Does SFM lead to more efficient timber production? This is an excellent suggestion as one additional outcome that should be considered when evaluating the outcomes of SFM, because one of the goals of SFM is to ensure the long-term economic viability of logging, and efficiency is a key factor. However, we caution against using the metric of efficient timber production as the "more appropriate" indicator of the success of SFM. "Efficient" and "sustainable" are not synonymous (Damania et al., 2018). Indeed, timber production is only one goal of SFM in the Congo Basin. SFM is also supposed to ensure biodiversity conservation, reduce deforestation, ensure long-term availability of economically-viable timber stocks, and generate societal benefits according to its advocates. Empirical research on Congo already indicates that industrial logging, in the absence of sustainability concerns, accelerates bushmeat hunting (Poulsen et al., 2009), devastates elephant populations (Maisels et al., 2013), leads to the disappearance of intact forest landscapes even in certified concessions (Kleinschroth et al., 2017; Potapov et al., 2017), and negatively affects local communities and livelihoods (Rist et al., 2012). Empirical analyses also suggest that timber extraction rates in the region would need to be reduced by up to a half to allow adequate regeneration time for future timber stocks (Karsenty and Gourlet-Fleury, 2006). Furthermore, more efficient extraction of natural resources may well lead to higher levels of extraction, a common phenomenon that environmental scholars have come to refer to as the *rebound effect* or Jevons' Paradox (Lambin and Meyfroidt, 2011; Polimeni et al., 2015). Simply put, the metric of timber production efficiency suggested by Karsenty et al. (2017) is not adequate as a measure of success of SFM in reducing deforestation in the Congo Basin.

The Karsenty et al. (2017) analysis is also fraught with several violations of standard practices in policy impact analysis. First, as they acknowledge, their analysis is a "simple comparison", *i.e.*, not a counterfactual analysis. Simple comparisons can be useful, but are commonly vulnerable to selection bias, *i.e.* the systematic allocation of management regimes to areas where deforestation is more/less likely to occur. A critical inadequacy of simple comparisons is that they do not attempt to understand the factors driving deforestation in Congo, nor control for those factors when comparing FMP with no-FMP concessions. For example, forests have a higher probability of being cleared if they are in areas that are easily accessible to humans. Karsenty et al. (2017) make no attempt to quantify how strongly such "drivers" influence deforestation in Congo, much less do they attempt to control for them in their comparisons.

To compute the "Gross Deforestation" value, Karsenty et al. (2017) use a satellite-derived deforestation dataset that is of unknown quality, because sufficient details are not provided in the response or in the source document that they reference (BRLi and Ecosolutions, 2014). The lack of supporting information makes it difficult to assess the validity of their claim, as satellite-derived deforestation datasets can vary widely in their quality and accuracy. Three criteria are typically used to assess whether a dataset is reliable: a) has a rigorous accuracy assessment been conducted?; b) is the dataset published in a peer-reviewed journal?; and c) is the dataset publicly available so that other analysts can determine its quality? The deforestation dataset used in Karsenty et al. (2017), as far as we can tell, satisfy none of these criteria. On the other hand, the datasets used in our analysis satisfied all three criteria. One of the datasets in particular (Hansen et al., 2013) is publicly available and has been used widely by scientists for similar studies (with citations in 1147 other peer-reviewed articles (as of June 26, 2017, from ISI Web of Knowledge)). More transparency and systematic research into the relative strengths and weaknesses of different datasets for characterizing forest loss in the Republic of Congo would help add clarity to this debate.

4. Conclusion

Karsenty et al. (2017) advance several critiques of our analysis. We welcome the opportunity for scholarly exchange and debate. However, we find that many of their criticisms are not well founded, and that their response does not present empirical data or analysis that contradict the conclusions of our original article.

Nonetheless, we appreciate the contribution in Karsenty et al. (2017) because the conversation enables identification of several knowledge gaps about industrial logging in the Congo Basin. We are in agreement that the impacts of SFM-based industrial logging in tropical forests are alarmingly understudied. Available evidence suggests that negative social and environmental outcomes are known to occur throughout the region. Better data, its analysis using appropriate covariates of selection of forest areas into industrial logging concessions and of outcomes relevant to sustainable forest management, and greater interactions among Anglophone and Francophone research worlds interested in the region will strengthen the prospects of more informed policies to govern tropical forests. Given the possibility of rebound effects, we caution against the use of efficiency indicators at the expense of measures of overall social and environmental impact. Until such analysis shed more light on how FMPs and SFM affect forest use and timber extraction, we cannot assume that these strategies reduce tropical deforestation.

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