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Deforestation and timber production in Congo after implementation of sustainable management policy: A reaction to the article by J.S. Brandt, C. Nolte and A. Agrawal (Land Use Policy 52:15–22)

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ABSTRACT

This viewpoint paper presents a reaction to the article by Brandt et al. (2016). It highlights the complexities inherent to the attribution of deforestation impacts to policy interventions when using remote-sensing data. This critique argues that in the context of the Congo a suite of factors (i.e., population density in particular) other than those considered by Brandt et al. (e.g., type of forest, distance from roads and markets) play essential roles in determining the fates of forests. It also contends that care is needed when making decisions regarding which units will be included in the comparison group so that contextual factors and on-the-ground information are properly considered (e.g., when logging operations are inactive or when a concession is used for 'conservation' purposes). Finally, it proposes that a focus on an analysis of deforestation rates for a given level of timber production might be a metric that more accurately represents one aspect of the consequences of forest management, which should also consider the appraisal of trade-offs associated with a larger set of social, financial and ecological objectives.

1. Introduction

Brandt et al. (2016) use remote sensing data from the Republic of Congo to address whether: (1) 2005–2010 deforestation rates were lower in concessions with forest management plans (FMPs) than in those without (FMP vs. No-FMP); (2) deforestation rates declined after FMPs were implemented; and, (3) FMP imple-

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mentation affected wood production. They sourced data from the Satellite Observatory for Forests of Central Africa (OSFAC) databases (Potapov et al., 2012) and Hansen et al. (2013). We contend that the Brandt et al. (2016) article contains data and interpretations that both deserve scrutiny and a more detailed discussion, which we provide below.

The authors used a quasi-experimental matching analysis to compare the rates of forest cover change in FMP and No-FMP concessions as outcome variables, based on randomly selected 1 km^2 parcels.

Covariates used for matching were minimum distance to an active road, distance to the nearest settlement in existence in 2005, travel time to the nearest market, proximity to the Congo and Oubangui Rivers, elevation, average slope, and above-ground woody biomass. They concluded that: (1) deforestation rates were significantly higher in FMP concessions (by an average of 0.2%); (2) after the official starting date of FMP implementation, deforestation in six FMP concessions increased on average by 1.9 km^2/yr and in no case decreased; and, (3) concessions with FMPs had higher and more stable timber production, more extensive forest road networks and, consequently, more deforestation. The first conclusion was based on a comparison of matched 1 km^2 parcels in FMP and No-FMP concessions in the northern part of the country because there were no concessions in the south with registered FMPs. To arrive at the second conclusion, the authors matched parcels in randomly selected No-FMP concessions in both the north and south of the country with FMP concessions that were all in the north.

We agree with Brandt et al. about the importance of understanding the impacts of policy instruments that seek to achieve sustainable forest management goals, and overall welcome the use of remote-sensing methods as an approach that can provide estimates of the effects of a range of interventions. In this commentary, we argue that the conclusions posited by Brandt et al. are compromised by two related sorts of issues. First, there are methodological problems related to the selection of units to be included in their comparative analysis. Second, we question their interpretation of the implications of what an FMP is and achieves, as described below. We propose that a more informative outcome variable related to how FMPs might affect sustainable forest management (SFM) is the amount of deforestation per unit of timber harvested.

The focus of our collective work over many decades in a range of tropical forests has been to bring the concept of SFM into implementation and make it more of an on-the-ground reality. That is why in discussing some of Brandt et al. conclusions we include insights that we believe should be considered when framing analyses of the impacts of SFM on a range of issues: from the most ecological ones to political sustainability.

1.1. Problematic parcel selection criteria

We detect bias in the data selection process employed by Brandt et al. Specifically, (1) deforestation data from the south of the country are of low quality due to more persistent cloud cover (Duveiller et al., 2008); (2) road data are more readily available for FMP concessions precisely because they are required to provide detailed maps with such roads. This situation, as pointed out by the producers of one of the main road datasets used in the analysis (WRI and MEFDD, 2012), renders their comparison with No-FMP concessions liable to reporting biases; and (3), at least three of the forest management units (FMUs) (note that a concession can be comprised of several FMUs) used by the authors as non-FMP parcels (i.e., Pikounda Nord, Tala-Tala, and Jua-Ikié) were not in operation for their entire study period.

In the online-available "Supplementary materials" to their article, Brandt et al. explain that deforestation is very high along the Oubangui River, an important transportation waterway with a high population density. The authors consequently excluded from their matching analysis points <15 km from the river as shown on their map SI-4 (Fig. 1). Due to this selection criterion, their analysis did not include parts of the FMUs Bétou and Mimbeli-Ibenga that did not have FMPs during the studied period and that suffered high rates of deforestation (nearly 1% per annum) for 2000–2010 (BRLi & C4 Ecosolutions, 2014). This exclusion means that deforestation rates are underestimated in No-FMP FMUs given that numerous parcels with high rates of deforestation were not selected. In contrast and without clear justification, the Pikounda-Nord FMU was included among those in the No-FMP group even though it was not harvested during the study period; that FMU is managed as a 'conservation concession' and it thus experienced by its nature neither industrial logging nor deforestation.

Some of the analytical methods employed by Brandt et al. need clarification. For example, it is unclear why human density is treated as a deforestation factor that is *endogenous* to FMPs but *exogenous* to No-FMPs. Given the importance of local population density, it is unclear why they included FMUs within 15 km of the city of Ouesso, the administrative capital of the Sangha Department that borders the Ngombe and Pokola FMUs, both of which have FMPs (Fig. 1). For reasons that are unspecified, their analysis does not consider National Road 2, which crosses 80 km of the FMP Ngombe FMU and was reopened and rehabilitated in 2004 in the Sangha Department. That road is an exogenous deforestation factor, potentially as powerful as the Oubangui River. Whether a high population density (responsible for high deforestation rates) is attributed to the presence of an industrial center, to a main road built by the State close to a provincial capital, or to the combined effect of both factors needs to be considered to assess its likely influence on the outcome. Brandt et al. chose to attribute the high population density to the presence of an industrial center, a decision that at least warrants discussion and an in-depth analysis of local demographic histories.

It seems worth noting that during the period covered by the analysis of Brandt et al., the only concessions with validated FMPs were in the north, whereas all the concessions in the south and some in the north lacked FMPs. Deforestation rates are much higher in the more populated Southern Congo (i.e., >0.2% per annum during the 2000–2010; BRLi & C4 Ecosolutions, 2014). In Northern Congo, two FMUs that are part of the same concession lacked FMPs but experienced very different deforestation rates: 0.1% per annum for Bétou, close to the Oubangui River (the area excluded by Brandt et al.) and 0.01% for Missa, more distant from the river and less populated. These remarks illustrate that local population density seems more powerful than other factors, especially the presence or absence of an FMP. We also stress the challenge of using matching methodologies to attribute with any certainty an effect to a residual causal factor.

The authors attribute differences between concessions with and without FMPs to: (1) the more extensive road networks associated with higher and more stable timber production driven by international market demands for wood from responsibly and legally managed forests (FMPs); and, (2) greater pressure from human activities in concessions with FMPs. We agree with Brandt et al. that the effective implementation of FMPs indicates a logging company's commitment, which may also be reflected in their generation of more and better employment opportunities than concessions without FMPs. Indeed, contributions to local community development and the implementation of social programs in the form of legally required "*social contracts*" are characteristic of responsibly managed concessions (e.g., those certified by the Forest Stewardship Council). Roads and economic development together stimulate human population growth in responsibly managed concessions ("*Economic development* [...] *has led to a 69% growth in human population* [...]"), which increases pressure on resources

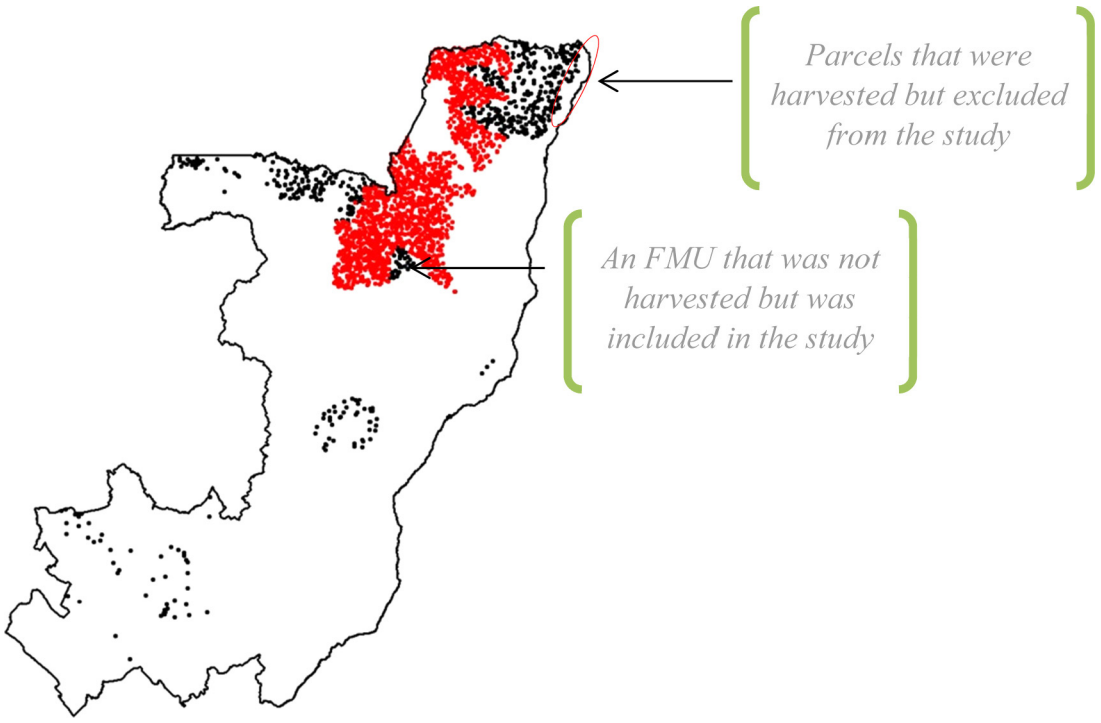

Fig. 1. (Adapted from Brandt et al., 2016): Map (SI-4) of FMUs with FMPs (red) versus No-FMP (black) (annotations inserted).

Table 1
Aggregate figures for deforestation versus production in north Congo based on annual statistical reports from the Forest Ministry in the Republic of Congo and deforestation data from BRLi & C4 Ecosolutions (2014).

Gross deforestation (ha)	Wood production 2003–2010 (m^3)	Gross deforestation/1000 m^3
FMP concessions		
11,359	5,039,205	2.25 ha
No-FMP concessions		
4290	861,570	4.98 ha

and land that may result in some deforestation for agriculture to feed the growing population. For this very reason, the law in the Republic of Congo also mandates logging companies to establish so-called "community development areas" in their granted concessions where the local people can farm. Brandt et al. do acknowledge the contributions of responsible forest management to economic development. They also recognize the social benefits of enforcement of national laws that require the creation of on-site processing units and other social obligations including the provision of health centers, schools, and transportation infrastructure. Surprisingly, the article then fails to acknowledge that these contributions to social welfare unavoidably result in increased local populations that, in turn, increase forest clearing.

1.2. FMPs and implications for SFM practices

Over the past decade, many tropical governments required that FMPs be prepared, but there are few data about their actual implementation and related on-the-ground impacts (e.g., Cerutti et al., 2008 for Cameroon). In their analysis, Brandt et al. did not assess whether the FMP guidelines were actually implemented nor even assess their quality (i.e., content analysis). These considerations are important given that whether or not a concession had a FMP was the treatment they assessed. In general, the mere *existence* of an officially approved FMP is neither a quality guarantee nor an indication of its correct implementation on the ground. In the case of Congo, however, both Forest Stewardship Council (FSC) certification as well as legality verification are granted to companies on the premise that they are indeed implementing their respective FMPs. In the case of this study, most companies with FMPs have been granted one or both of the certified and legally verified management status, so we do not question Brandt et al.'s assumption.

One concern is that for their comparisons of deforestation rates before-and-after FMP, Brandt et al. (2016) assume that the date of official FMP registration with the government represents the start date for FMP implementation. Such analyses can be revealing, but in this case would need to take into account both the adoption of FMP guidelines before official FMP registration (i.e., anticipatory effects) as well as the direct and indirect effects of a range of confounders (i.e., changes in timber markets and lag-times in FMP implementation) in FMUs in both treated and untreated groups. More importantly and even if the FMPs were implemented, the impacts would be expected to vary among FMUs in different forests that serve different markets with different products and that are run according to different business models.

Forest policies in general and FMPs in particular seek to diversify the gamut of harvested species so as to intensify logging and concentrate the impacts of the harvests. In other words, the objective of the FMPs in the region is to move away from decades of highly selective and widely dispersed logging. In concessions that lack FMPs, in contrast, widely dispersed logging remains the norm (i.e., "high-grading", "creaming" or "timber mining"); only the most valuable species are targeted, generally without any consideration of sustainability. For that reason, and in contrast to the approach taken by Brandt et al., logging intensity should not be confused with or interpreted as a consequence of mandatory, legal requirements reflected in FMPs. We therefore question their claim that: "*. . . the highly selective logging required by FMPs may encourage timber companies to spread out logging activities over larger areas and exploit interior forests*" (Brandt et al., 2016, p. 20). Highly selective

logging is not "required" by forest management plans nor by the law (République du Congo, 2000).[1]

1.3. Deforestation from timber production: a criterion for efficiency

Forest concessions represent a land management policy instrument used by states to spatially segregate areas designated for production from protected areas and other land use categories. Productive areas are meant to produce timber, under the condition that stocks are reconstituted over the course of felling cycles. Given this objective for production areas, we suggest that a more appropriate outcome variable to use to compare FMUs with and without FMP is deforestation per cubic meter of timber harvested. Adoption of this perspective leads to the following question: "Production being equal, which forestry logging practices generate the lowest rate of deforestation?" The same approach is used to determine energy efficiency in the context of climate change issues (e.g., what technologies generate the lowest greenhouse gas emissions?) for a given type of production (steel, electricity, cement, etc.). Brandt et al. associate the presence of FMPs with higher timber production rates that may have led to more short-term deforestation. However, their analysis does not allow conclusions about efficiency in terms of deforested area per volume of timber produced. A naïve comparison of FMP and No-FMP concessions using this proposed outcome variable is presented in Table 1, while we await to perform a proper counterfactual analysis (Ferraro, 2009) that could reveal the drivers of deforestation in managed forests and as such, the extent to which differences in deforestation are due to the existence of an FMP (Table 1).[2]

2. Conclusion

The dynamics of interacting factors related to the existence and implementation of FMPs and their effects on deforestation need to be considered in a robust counterfactual analysis framework so as to avoid systematically attributing to FMPs a greater-than-deserved effect. In the context of the Congo, there are factors other than FMPs (e.g., population density and migration) that play essential roles in determining the fates of forests. A well-informed theory-of-change could help make explicit and disentangle the range of scales at which these factors operate. Decisions made by Brandt et al. about whether or not to include specific parcels in their analysis imply the existence of a tacit theory-of-change that assigns weights and values to the different drivers of deforestation. We believe it is important to make such a theory explicit so as to enable debate and potential contestation of the results. In particular, if the focus remains on logging concessions with or without FMP, we suggest estimating deforestation rates for a given level of timber production, with the caveat that the registration of an FMP with the government does not mean that the plan is actually implemented. Yet, the use of robust methodologies such as matching does not guarantee that reasonable conclusions will be reached, especially when there are complex issues at play and when important contextual factors and on-the-ground information are ignored (e.g., when logging operations are inactive or when a concession is used for 'conservation' purposes). More fundamentally, we wonder what are the effects that well-implemented FMPs are supposed to have on deforestation. The objective of specifically linking FMPs to timber harvesting, which is only one component part of a larger set of ecological, social, financial, and governance objectives is, above all, to allow for the long-term recovery of harvested species, in line with the principle of sustainable yield.

We hope that this discussion helps highlight some relevant policy issues. Most importantly, it brings to the fore the impact of settlement growth linked to the creation of jobs and social programs that result from proper implementation of FMPs by logging companies. This linkage deserves attention from logging companies and public authorities, but should also be taken into account in future studies of the relationship between forest management and deforestation. Another important factor that was acknowledged by Brandt et al. but that deserves further emphasis, is that it is questionable to evaluate the admittedly long-term process of forest management on the basis of short-term studies of deforestation rates. When properly formulated and implemented, forest management plans strike a balance between socio-economic development and natural resource conservation. It is nevertheless important to stress that such plans can be improved through, for example, third-party certification, recognition of customary land rights, benefit sharing, accommodation of multiple uses, and better enforcement, all of which deserve more attention (e.g., Cerutti et al., 2017).

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[1] In Congo, the harvest intensity is <1 tree harvested per hectare (6–10 m^3/ha on average).

[2] Other naïve comparisons with detailed deforestation data are included in Karsenty et al. (2016).