

## Research Letters

## Beyond the mining pit: the academic role in social deliberation for participatory environmental planning



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## ARTICLE INFO

## Article history:

Received 30 November 2016

Accepted 15 June 2017

Available online 7 September 2017

## Keywords:

Environmental planning

Master Plan

Mining impacts

Participatory process

Rio Claro

## ABSTRACT

Although mining activities are required to supply human needs, the academic participation on the allocation and planning of mining activities is reduced. We presented our experience in the participatory review of Rio Claro's (São Paulo, Brazil) master plan. In 2015, Rio Claro City Hall triggered a multi-agent discussion about new perspectives on local environmental planning to improve human life quality. Representatives of economic sectors were invited for public consultations, while civil society was neglected. The academic participation was represented by amendment proposals that intended to represent common interests of society (e.g.: reducing the impacts of clay extraction on the population). We discuss the need of greater appreciation of university outreach initiatives for their high impact on public issues. Academia may ensure an equitable balance of interests between different sectors of society, aiding in the pursuit of quality of life improvement and natural resources preservation for future generations.

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## Introduction

Current global economic development is largely based on mineral extraction leading to intense environmental degradation, particularly in developing countries where the economic base is primarily commodity exports. Worldwide, increasing consumption of goods and services is heightening the demand for minerals. For example, the Brazilian Government expects increases of 217% in iron production and 466% in copper production by 2030 (Brasil, 2010). This scenario will further increase the mining sector's political and economic influence, creating the need for strategies that ensure sustainable development and regulate mineral extraction and production (e.g.: Caron et al., 2016) and avoid a retrogression in mining regulation (Meira et al., 2016).

To ensure that social and environmental issues are fairly addressed while planning the spatial distribution of mining

activities, the formulation process should include active participation not only from economic sectors but also from academia and society. Mineral extraction should occur in regions that have been defined through social deliberation to maintain the integrity of social–ecological systems (Vela-Almeida et al., 2015). Academia's technical expertise makes it a key actor in the identification of the most ecologically sensitive areas and regions at different scales. Different aspects must be considered when balancing the benefits and costs of mineral extraction beyond the mining pit, such as the location of freshwater resources, conservation units, geological formations and human settlements. However, academic participation in the management and planning of the localization of mining activities has been extremely limited.

We systematically assessed studies related to this topic, conducted in different parts of the world at scales ranging from global to national to local (for more details see S1 Text). From the 25 studies conducted in 13 different countries, we observed that most studies (18) were published after 2010, and only seven included some aspect of participatory planning. Most studies aimed to extrapolate local perceptions to the broader application of planning, based on case studies that ranged from resource location to

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state-level analyses (S1 Text). Mining activity planning is closely linked not only to resource distribution (as we identified in six studies) but also to local administrative boundaries (seven studies) and immediately affected areas (delineated, for instance, by basins or water catchments in four studies). Despite the practical information these studies provide, academia generally acts as an external agent of investigation, not as a vector of improvement in planning or the active transfer of knowledge into practice. Meanwhile, decision and policy makers are often expected to passively assimilate this knowledge.

In this study, we describe academia's participation in the formulation of a new master plan for the city of Rio Claro (São Paulo, Brazil), which includes public policies and directives for reducing the high impacts of sand and clay extraction in its territory. Due to the impacts of the main economic activities (mineral extraction, sugarcane cultivation and cattle ranching) in Rio Claro, the city has the second highest level of suspended particulate matter in São Paulo State (CETESB, 2016), and 54% of its 1447 springs and streams are disturbed or degraded (PMRC, 2014). Municipal master plans can be strategic for local planning and for specifying best practices in mineral resource management. Master plans in Brazil are defined by a specific bill and regulated by a Federal law (Brasil, 2001). They must state priorities and directives for urban growth and development, and they must be transparent, democratic and participatory, open to public criticism and evaluation (Brasil, 2001). We demonstrate that academic participation in the master plan's development may be critical to ensure an equitable balance of interests between different sectors of society (Fig. 1).

### Formulation of the new master plan

Rio Claro is a medium-sized municipality covering 498.7 km<sup>2</sup>, located in São Paulo State, southeastern Brazil (Fig. 2). The last population census reported approximately 200,000 inhabitants, with 97.6% living in the urban areas (IBGE, 2016). Located in the ecotone between Atlantic Forest and Cerrado biomes, Rio Claro has a 66% deficit in natural vegetation according to the Brazilian Forest Code (Soares-filho et al., 2014). The population is aware of the environmental degradation of the landscape, and acknowledge the necessity of investments in restoration projects (Silva et al., 2016). Thus, the new Rio Claro Master Plan (RCMP) aimed for the first time to organize the municipality's rural areas and urban perimeter. Besides planning and organizing urban space, the proposal also regulates different economic activities in the city's periphery. According to the Brazilian Statute of Cities, a master plan needs to be reviewed at least every 10 years (Brasil, 2001). Without a valid and effective master plan, the City Hall has no guidelines by which to promote or oppose new economic initiatives. In 2015, Rio Claro's City Hall assigned a commission within the Municipal Secretariat for Urban Planning, Development and Environment (SEPLADEMA) to lead the participatory reformulation of the master plan, assisted by specialist consultation. The commission prepared a first draft based on technical documents, such as *Rio Claro's Environmental Assessment* (PMRC, 2014) and the *Mineral Production Map of the State of São Paulo* (IPT, 2013), and several public consultations with representatives of different economic sectors: farming, mining, civil engineering and industry.

Academic representatives were invited to the public consultations—mainly professors from the São Paulo State University Júlio de Mesquita Filho campus in Rio Claro, hereafter UNESP—but civil society was highly neglected (Fig. 1). Therefore, PhD candidates and undergraduate students from UNESP, who attended several public consultations, formed a working group and formulated fourteen amendment proposals for the new RCMP. These proposals intended to represent the common interests of

society, considering general aspects for sustainable development of the city, environmental conservation, improvement of human quality of life and the spatial organization of mining and other rural economic activities (S2 Text). The group members discussed issues related mainly to the urban and rural environments within their expertise to propose solutions and new amendments that would benefit society and not a particular economic sector. During this process, the group had weekly meetings and online forums via social media, which were instrumental in informing other academics and civil society in general about the new RCMP formulation and academic participation. Unfortunately, there was no time to mobilize civil society and discuss their aspirations.

The proposed amendments were presented and held to a vote in a public audience before SEPLADEMA's commission, economic sectors and civil society representatives. Mobilization and participation of undergraduate students of UNESP played an important role in the approval of thirteen of the fourteen amendments. Notably, the mining sector did not present amendments on that occasion.

SEPLADEMA's commission incorporated UNESP's and other approved amendments into the final draft of the new RCMP. This document was sent to the City Council for assessment. One of the most important points of this final draft was the definition of five macrozones with different economic purposes or environmental restrictions within the municipal boundary: a) Economic and Rural Development, b) Rural Development and Forest Management, c) Conservation and Sustainable Use, d) Urban and e) Protective Boundary (Fig. 2). Within each macrozone, specific economic activities were permitted according to their environmental and social sensitivities and characteristics (Table S1). For example, the Protective Boundary Macrozone aimed to reduce the direct impacts of clay and sand extraction on Rio Claro's population. Currently, there are several clay pits just a few meters from the urban fringe (Fig. 2).

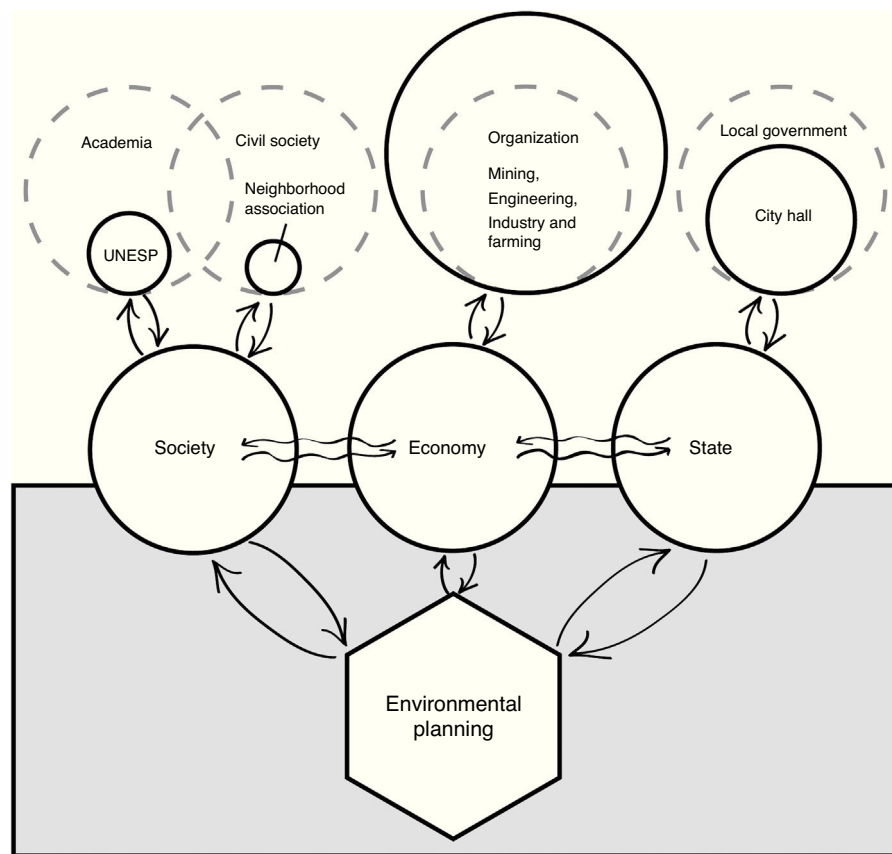
### The master plan approval process

The City Council presented the document at two public hearings. The participation of civil society and academic representatives was again crucial to defend the final draft of the new RCMP. Their participation materialized through cooperation between the Rio Claro Lawyers' Organization, which provided legal reinforcement to the environmental and social demands, and UNESP, which provided technical support.

The first hearing occurred with intense academic and social participation. Most representatives supported maintaining the final draft of the new RCMP as it was. The Protective Boundary Macrozone received special attention for its potential to minimize the direct impact of mining on urban population wellbeing.

The mining sector attended the second public hearing, represented by a regional association of coating ceramics (ACC). They presented data highlighting the economic importance of mineral extraction and ceramics production expansion in Brazil, particularly in São Paulo State. ACC also presented the current spatial limitation of mining activities due to resource location in Rio Claro, noting that the area defined as the Protective Boundary Macrozone is of great importance for the municipality due to its abundance of clay reserves. Impeding mining expansion in those areas may affect Rio Claro's economy negatively. However, a prosecutor from São Paulo Public Ministry (SPPM) declared that no ACC amendment proposal would be accepted before the association performed a proper technical study.

In bill approval processes, the alderman can usually submit their amendment proposals—which can be influenced by public hearings and economic interests—up to 24 h before voting. At the second



**Fig. 1.** The influences of the different social agents on environmental planning. Black solid lines represent the unbalanced scenario of most Brazilian cities, such as Rio Claro, in which the economic sector's influence prevails. Gray dashed lines represent the scenario with balanced influences of the different social agents.

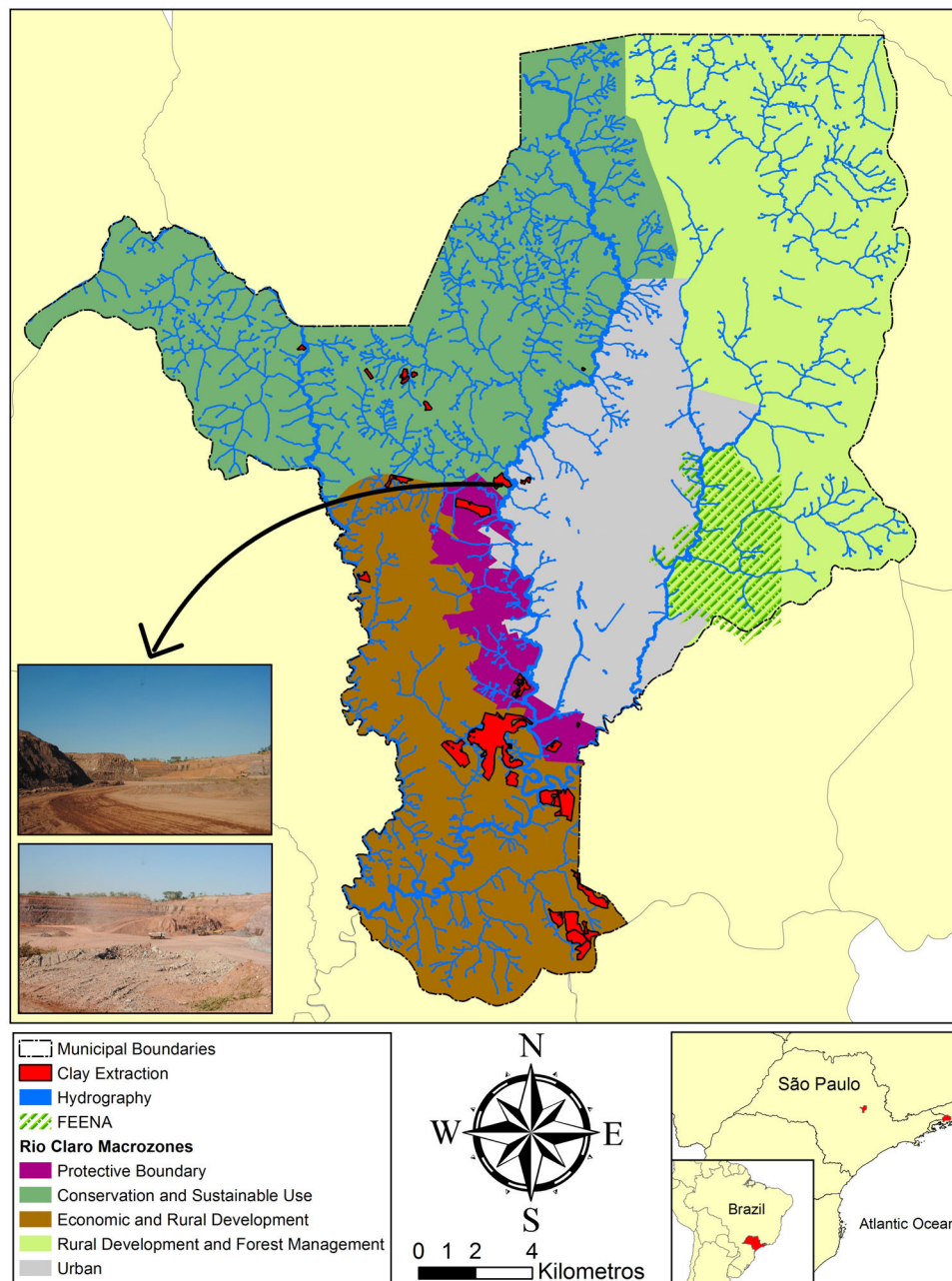
public hearing, the academic representatives expressed their concern that such a short time would limit population awareness of any modifications in the document. Therefore, the City Council defined a deadline for the aldermen's amendment proposals and held a public plenary session (S3 Text) prior to the vote; this was considered a victory for civil society and academic representatives.

Prior to the public plenary session, the UNESP working group assessed the amendments proposed by the aldermen, available on the City Hall website. The amendments intended to allow small mining enterprises within the Conservation and Sustainable Use Macrozone and the Protective Boundary Macrozone. In São Paulo State, a mine is considered small when the effective area of mineral extraction is  $\leq 30$  ha for clay and  $< 50$  ha for sand (São Paulo, 2014). Although considered small, the cumulative effect of all mining pits and the area directly affected by this type of activity is extensive (Fig. 2). The permission of small mining enterprises within the Conservation and Sustainable Use Macrozone and Protective Boundary Macrozone would nullify more than a year of open discussions and the participatory formulation of the master plan. However, during the public plenary session, the City Council stated that the amendments proposed by the mining sector were not included in the new master plan. Moreover, the amendments proposed by UNESP's working group were not modified. The ACC representatives then made a request to postpone the master plan vote. That request was denied by the City Council.

The master plan vote was initially scheduled for May 2016 (S3 Text). However, half of the aldermen—mostly from opposition political parties—requested access to the document, and deliberation was postponed for 120 days. Municipal elections were held in October 2016, with the newly elected mayor and most of the elected aldermen representing the main coalition in

opposition to Rio Claro's political mandate for 2013–2016. Furthermore, although the vote on the new RCMP should have taken place before the municipal elections, it was not included in the 2016 agenda (S3 Text). In March 2017, the elected aldermen requested access to the document and deliberation was again postponed for 120 days. The defined Macrozones and the limitation of mining activities were one of the main reasons for this request. On May 2017, new public hearings were held to clarify the socio-environmental impacts of mining activities in Rio Claro to the aldermen and the population. However, only seven out of 19 aldermen attended the event. During the public hearings, the UNESP working group highlighted the importance of limiting economic activities, with special attention to mining, in environmentally and socially sensitive regions. We also claimed the need of a more detailed definition of the Macrozones, considering physical aspects of Rio Claro's landscape, and the identification of the most suitable areas for mineral extraction. Thus, it will be possible to conciliate economic development and environmental protection, restricting this economic activity to certain regions that, if exploited, will not have profound impacts on the environment and on human wellbeing.

Thus, the approval of the new RCMP is uncertain. Equally uncertain is whether any points in the document will be altered. The new government may decide to archive the current proposal and elaborate a new one. Whether the objectives of the new government will favor economic activities instead of environmental and social issues is still unknown. Once again, the fate of Rio Claro relies on society's and academia's involvement in this issue. Having a master plan that prioritizes human wellbeing and environmental conservation is a first step in ensuring local sustainability and avoiding juridical maneuvering.



**Fig. 2.** Macrozones defined in the first draft of the new Rio Claro Master Plan, highlighting municipal hydrography and clay extraction pits. The pictures show a small-scale clay extraction near the urban fringe. FEENA: State Forest Edmundo Navarro de Andrade.

### Lessons learned and potential implications

In a municipality such as Rio Claro – and in most Brazilian cities – where the participation of civil society in public issues is minimal, the involvement of academic representatives was a great achievement. Academia can catalyze the inclusion of citizens in participatory processes. Planning land-use modification requires long term perspectives and goals for society's wellbeing. The new RCMP aimed to enhance water resources conservation, incentivize environmental conservation and restoration (e.g. via Payment for Ecosystem Services), and reduce mining extraction near the urban fringe. Mining can severely impact several ecosystem services (Bian and Lu, 2013). Even with the mandatory plans for restoration of degraded areas (acronym in Brazil: PRAD) after mining activities, the area can only recover to a certain degree. It is important to highlight that in many cases, PRADs may not be put

into practice. Fines and environmental compensation agreements are rarely enforced in Brazil due to the considerable political power of the mining sector and of larger companies in particular (Garcia et al., 2016; Spiegel et al., 2012). Recent social-environmental disasters have demonstrated the weakness of Brazilian environmental impact assessments and mineral extraction licensing (El Bizri et al., 2016).

It seemed a genuine intention of City Hall to balance the high environmental impact and economic value of mining activities with local demand for quality of life. However, backstage negotiation indicated that political influences were delaying the process of approving the new RCMP. The role of academics, the Rio Claro lawyers' organization and the SPPM prosecutor were critical in the defense of environmental and civil society interests. In our literature review, the only Brazilian study addressed the importance of interdisciplinary participation (academia, practitioners, policy

makers and stakeholders) in surveillance projects for mining activities (Spiegel et al., 2012). Participatory processes are crucial due to the political power of large-scale industrial extraction companies in Brazil (Spiegel et al., 2012).

The current academic productivity assessment system, which overemphasizes publication in scientific journals that are accessed by a few academic peers (Evans, 2008) but rarely accessed by civil society and especially stakeholders, greatly devalues academic outreach. However, academia is ideally suited for direct involvement in decisions related to social and environmental issues. The knowledge produced and acquired within universities must be directly applied in the formulation of laws and policies that make economic activities socially responsible and environment-friendly. Likewise, institutions responsible for research funding should recognize and value university's outreach initiatives for their direct impact in society. With this type of recognition, researchers would be willing to bridge the abyss between science and policy. University outreach initiatives that boost knowledge and innovation beyond campus have an enormous potential to contribute in participatory planning and decision-making.

Rio Claro has the privilege of having an excellent university, with professionals engaged in improving the population quality of life and the sustainable development of the municipality. However, most municipalities are not that privileged. The Academia's active participation is essential to expand its influences on decision making within a broader range of local governments. Such upscale requires not only the academia's participation, but also the engagement of and collaboration with local governments, NGOs and civil society representatives that want to participate and take action. All these actors should be constantly engaged in participatory decision making.

Mining within Rio Claro will continue because its importance is recognized. The proposed amendments intend only to regulate these activities and restrict them in environmentally and socially sensitive areas. Considering the current scenario of very limited academic participation and an interest in the active transfer of knowledge into regulatory practices for mining activities, we expect that the experience described in this study will stimulate students and professors from various universities to apply their technical knowledge to decisions that involve social interests. The formulation of amendment proposals for the new RCMP started as a working group related to an undergraduate course at UNESP. However, it evolved into an extremely positive experience, especially for undergraduate students, engaging the academic community in the pursuit of improvement in quality of life, environmental conservation and preservation of natural resources for future generations.

### Conflicts of interest

The authors declare no conflicts of interest.

### Acknowledgements

We thank the undergraduate students of UNESP for their mobilization and participation during the formulation and approval process of the Rio Claro Master Plan. We also thank F.F. Goulart, A.P. Paglia and G.W. Fernandes for their valuable contributions to our work. This work was supported by Conselho Nacional de Desenvolvimento Científico e Tecnológico (<http://www.cnpq.br/>) grant number 312045/2013-1 (MCR); Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (<http://www.capes.gov.br/>) (JCCP and RAS); and Fundação de Amparo à Pesquisa do Estado de São Paulo, grant number 2013/50421-2 (<http://www.fapesp.br/>) (MCR).

### Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at [doi:10.1016/j.pecon.2017.06.006](https://doi.org/10.1016/j.pecon.2017.06.006).

### References

- Bian, Z., Lu, Q., 2013. Ecological effects analysis of land use change in coal mining area based on ecosystem service valuing: a case study in Jiawang. *Environ. Earth Sci.* 68, 1619–1630.
- Brasil, 2010. Plano Nacional de Mineração 2030. Geologia, Mineração e Transformação Mineral. Ministério das Minas e Energia, Brasília.
- Brasil, 2001. Lei Nº 10.257, de 10 de Julho de 2001 – Estatuto da Cidade.
- Caron, J., Durand, S., Asselin, H., 2016. Principles and criteria of sustainable development for the mineral exploration industry. *J. Clean. Prod.* 119, 215–222.
- CETESB, 2016. Qualidade do ar no estado de São Paulo. CETESB, São Paulo.
- El Bizri, H.R., Macedo, J.C.B., Paglia, A.P., et al., 2016. Mining undermining Brazil's environment. *Science (80)* 353, 228–228.
- Evans, J.A., 2008. Electronic publication and the narrowing of science and scholarship. *Science (80)* 321, 395–399.
- Garcia, L.C., Ribeiro, D.B., de Oliveira Roque, F., et al., 2016. Brazil's worst mining disaster: corporations must be compelled to pay the actual environmental costs. *Ecol. Appl.*, <http://dx.doi.org/10.1002/eap.1461>.
- IBGE, Instituto Brasileiro de Geografia e Estatística, 2016. Cidades. URL <http://cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=354390&search=sao-paulo%7Crio-claro> (accessed 02.05.17).
- IPT, Instituto de Pesquisas Tecnológicas, 2013. Mapa da Produção Mineral do Estado de São Paulo.
- Meira, R.M.S.A., Peixoto, A.L., Coelho, M.A.N., et al., 2016. Brazil's mining code under attack: giant mining companies impose unprecedented risk to biodiversity. *Biodivers. Conserv.* 25, 407–409.
- PMRC, Prefeitura Municipal de Rio Claro, 2014. Diagnóstico ambiental e desenvolvimento de implementações de projetos de recuperação da qualidade dos corpos d'água. São Paulo, 2014. Decisão da Diretoria, nº 025/2014/C/I de 29 de Janeiro de 2014.
- Silva, R.A., Lapola, D.M., Patricio, G.B., et al., 2016. Operationalizing payments for ecosystem services in Brazil's sugarcane belt: how do stakeholder opinions match with successful cases in Latin America? *Ecosyst. Serv.* 22, 128–138.
- Soares-filho, B., Rajão, R., Macedo, M., et al., 2014. Cracking Brazil's forest code. *Science (80)* 344, 363–364.
- Spiegel, S.J., Ribeiro, C.A.A.S., Sousa, R., et al., 2012. Mapping spaces of environmental dispute: GIS, mining, and surveillance in the Amazon. *Ann. Assoc. Am. Geogr.* 102, 320–349.
- Vela-Almeida, D., Brooks, G., Kosoy, N., 2015. Setting the limits to extraction: a biophysical approach to mining activities. *Ecol. Econ.* 119, 189–196.