Brazil's endangered postgraduate system

Over the past decade, Brazilian scientists have faced a dramatic reduction in financial support (*1*–*3*). In 2017, the Ministry of Science and Technology had a budget of only 2.8 billion reais, the equivalent of US$700 million (*4*), the lowest in the past 14 years (*5*). Dwindling funding affects a crucial population in Brazil's scientific system: students working toward master's and Ph.D. degrees.

Brazil's postgraduate system plays a pivotal role in scientific output. A major portion of scientific research takes place in publicly funded universities, and most scientific publications are driven by postgraduate programs (*6*, *7*). Brazil's 6303 master's and Ph.D. programs (*8*) are primarily funded by the Coordination for the Improvement of Higher Education Personnel (CAPES), a governmental agency within the Ministry of Education (*9*). The CAPES budget has plunged from the equivalent of US$1.9 billion in 2015 to the equivalent of US$1 billion in 2018 (*10*). The budget for 2019 projects an additional cut of nearly 40% (*11*). The funding cuts will likely translate into a substantial drop in federal grants, postdoctoral fellowships, support for international collaborations, and student scholarships. As student support falls, scientific output will likely decrease as well.

Brazil's scientific enterprise cannot function without qualified human resources, who will in turn strengthen social and economic development. Despite the polarized political atmosphere, Brazil must implement a strategic plan to improve the quality of science and innovation by investing in the postgraduate system.

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REFERENCES

1. E. Gibney, *Nature* **526**, 16 (2015).
2. C. Angelo, *Nature* **533**, 19 (2016).
3. F. Marquez, "Funding in crisis," *Revista Pesquisa FAPESP* **256**, 1 (2017).
4. C. Angelo, *Nature* 10.1038/nature.2017.21766 (2017).
5. Ministério da Ciência, Tecnologia, Inovações e Comunicações, Recursos Aplicados—Governo Federal (2018); www.mctic.gov.br/mctic/opencms/indicadores/detalhe/recursos_aplicados/governo_federal/2_2_4.html [in Portuguese].
6. A. F. Helene, P. L. Ribeiro, *Scientometrics* **89**, 677 (2011).
7. E. A. Oliveira *et al.*, *Scientometrics* **90**, 429 (2011).
8. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Ministério da Educação, "Avaliação quadrienal em números" (2017); www.ucs.br/site/midia/arquivos/Avalia%C3%A7%C3%A3o_Quadrienal_em_n%C3%BAmeros.pdf [in Portuguese].
9. Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES), Plano nacional de pós-graduação (PNPG) 2011-2020 (2010); www.capes.gov.br/plano-nacional-de-pos-graduacao [in Portuguese].
10. Coordination for the Improvement of Higher Education Personnel (CAPES), "Budget—Evolution in Reais" (2018); www.capes.gov.br/orcamento-evolucao-em-reais [in Portuguese].
11. A. C. Moreno, "Quase 200 mil bolsistas da Capes podem ficar sem bolsa se orçamento de 2019 sofrer corte, diz conselho," globo.com (2018); https://g1.globo.com/educacao/noticia/2018/08/02/quase-200-mil-podem-ficar-sem-bolsa-se-orcamento-de-2019-sofrer-corte-diz-conselho-da-capes.ghtml [in Portuguese].

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Airborne in the era of climate change

The Intergovernmental Panel on Climate Change (IPCC) recently released its special report on limiting global warming to 1.5°C (*1*). The IPCC's 2050 target of carbon neutrality is strongly challenged by sectors with unavoidable emissions, such as aviation. Forecasts of the sector's growth predict that by 2050 it could have consumed up to one-quarter of the total global carbon budget for 1.5°C (*2*). The absence of substantial technical gains in aircraft emissions implies that reduction of aviation impact will be unfeasible without a decrease in demand (*3*). Air travel contributes substantially to the carbon footprint of academic communities (*4*), despite calls to travel less (*5*). In the current academic system, avoiding flying means accepting trade-offs, such as greater challenges to collaboration and networking. However, the cost of inaction and business as usual is the growing global threat of climate change, and scientists, given the alarms they regularly raise, should model responsible behavior to the planet. To encourage low-impact mobility, scientific institutions should adopt an avoid-mitigate-compensate approach similar to that developed in ecosystem conservation (*6*).

Air travel accounts for much of the science community's carbon footprint.

PHOTO: ISTOCK.COM/GUVENDEMIR

To avoid unnecessary journeys, institutions, department heads, and principal investigators should encourage scientists to consider or provide alternatives, such as teleconferencing and virtual scientific conferences. To mitigate emissions resulting from travel, scientists who must travel should replace flights with cleaner modes of travel as much as possible. Participants should prioritize local meetings, and organizers should reduce distances traveled by choosing central locations. To compensate for travel, scientists should financially contribute to credible and traceable projects for reducing and removing carbon emissions. This should be the last resort, given the questionable effectiveness of carbon offsetting (*7*).

There is increasing discussion about the best way to evaluate scientists, teams, and research projects (*8*), and including a carbon sobriety criterion could be a good way to reduce scientists' carbon footprint. Individual involvement is crucial, but supportive institutional environments [e.g., (*9*)] are also required to incentivize carbon-neutral behavior at the scale and speed required. Institutions invariably have policies for preventing and reducing harm, which address problems such as physical safety and data security. Surely the protection of planetary health, through the dramatic carbon cuts that are now urgently required, has a place in institutional policy, too.

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REFERENCES

1. "Global warming of 1.5°C," V. Masson-Delmotte *et al.*, Eds. (2018); www.ipcc.ch/sr15/.
2. "Analysis: Aviation could consume a quarter of 1.5C carbon budget by 2050," *Carbon Brief* (2016); www.carbonbrief.org/aviation-consume-quarter-carbon-budget.
3. A. Macintosh, L. Wallace, *Energ. Pol.* **37**, 264 (2009).
4. A. Stohl, *Atmos. Chem. Phys.* **8**, 6499 (2008).
5. X. Anglaret, *Lancet Planet Health* **2**, e382 (2018).
6. "An integrated framework and guidelines for avoiding, mitigating, and compensating for wetland losses: Resolution XI.9" (Ramsar Convention, 2012); www.ramsar.org/sites/default/files/documents/library/cop11-res09-e.pdf.
7. K. Hyams, T. Fawcett, *Wiley Interdisc. Rev.: Clim. Change* **4**, 91 (2013).
8. D. Moher *et al.*, *PLOS Biol.* **16**, e2004089 (2018).
9. Tyndall Centre, "Tyndall Travel Strategy—Towards a culture of low carbon research for the 21st Century" (2014); https://tyndall.ac.uk/travel-strategy.

10.1126/science.aaw1145