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Policy Forums

Science and democracy must orientate Brazil's path to sustainability

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ABSTRACT

In the search for solutions to social and environmental challenges, all world nations have contributions to give. Brazil is no exception. On the contrary, as a megadiverse country and emerging economic power, it has a central role in this process. Between 1995 and 2014 the country made important improvements in terms of human development, including higher education and environmental protection. However, the current economic and political crisis threatens such advances. By reducing science funding and sidelining scientific advice in strategic environmental decisions, Brazil has veered off its path to sustainability, and several positive trends have already been reversed. If Brazil is to contribute to solving the challenges of improving human well-being and conserving biodiversity, it must renew its commitment to science, education and democracy.

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Finding pathways to sustainability is a global work in progress, and each nation should contribute. In developing these contributions, critical components will be the application of scientific knowledge to improve human well-being and protect biodiversity, and increased participation of a well-educated and well-informed public. In the past two decades, Brazil has pursued such a path, but a more recent U-turn toward an anti-science political agenda threatens the future of the world's most biodiversity-rich country. What is happening in Brazil mirrors recent shifts in the political agenda of other countries, including the superpowers United States and United Kingdom and our developing neighbors Colombia and Argentina, with perverse consequences for people and nature. Here, we explore how science, environmental protection, and human rights have been deeply undermined in Brazil, when they should instead have been fostered to overcome crises and resume the pathway to human well-being and biodiversity conservation. We highlight the importance of a scientifically literate and engaged society to foster in-country political decisions for greater investment in biodiversity research programs and to support effective environmental policymaking.

Between 1995 and 2014 was the longest period of Brazilian democracy – defined here humbly, as when the president and representatives are elected by vote and complete their mandate. During that period, the country fought some of its historical problems of poverty, environmental destruction, and science and education shortfalls (Fig. 1; data and sources are available as online Supporting Information). Economic development occurred, considering increase in GDP growth, positive results in central government fiscal balance and minimum wage triplication (Fig. 1A–C). Environmental issues started being addressed as represented by creation of protected areas, the decline of deforestation rates in the Amazon and Atlantic Forest (Fig. 1G–I). Science funding increased (Fig. 1E) and more students entered higher education, with a five-fold increase in the annual number of graduate degrees (from 10.5×10^3 to 50.2×10^3 and 2.9×10^3 to 16.7×10^3 of masters and PhDs, respectively; CGEE, 2016)

However, 2014 represented a turning point in Brazilian route (Table S1). The first deficit in public accounts was observed in the last 20 years (Fig. 1B), driven by a decrease in revenue. This decrease is mostly attributed to reductions in economic activity, lower prices

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of Brazil's commodities and exports, resulting in the first deficit since 2000, rises in public expenditures to rescue the energy sector after water collapse (Dobrovolski and Rattis, 2015), and tax cuts in response to the 2008 world economic crisis (IFI, 2017). This economic scenario added to accusations of using public bank loans to mask the real economic situation and corruption scandals involving the giant semi-public (e.g. Petrobras) and private (e.g. J.B.S. S.A.) companies, set the opportunity for Congress to impeach the president, Dilma Rousseff in August 2016. She was succeeded by her vice-president, Michel Temer (Watts, 2016). Brazil went through its worst economic crisis since 1931, including GDP contraction in 12 successive quarters (Fig. 1A) and a tripling in the unemployment index affecting 13 million people (Fig. 1D). According to World Bank estimates, 2.5–3.6 million Brazilians were expected to fall back below the poverty line between 2016 and 2017, after 28.6 million had moved above it between 2004 and 2014 (Prengaman et al., 2017).

In 2017, Mr. Temer was involved in two scandals – accused of corruption, obstruction of justice and criminal organization leadership – that required the Congress to approve continuation of legal processes against him. Despite his 3% approval rate (the lowest of any president since 1985), Mr. Temer retained his post by persuading the congressmen with R$ 6.4 billion in parliamentary amendments and R$ 2.4 billion in tribute discharge. In addition, the "ruralist" lobby, representing the agricultural and extractive industries, convinced the government to abolish a protected area in Amazon and to issue a decree weakening the legal definition of slavery (Londoño, 2017). Both acts were revoked only after widespread protests.

The way these opprobrious decrees were exchanged for votes has much to say about how science, the environment and human rights have been managed in Brazil: instead of being considered as a patrimony to be protected and fostered for overcoming crisis and building a future of sustainable development, they are considered as expenses that should be cut. The new government fused the Ministry of Science, Technology and Innovation with the Ministry of Communications, minimizing the political importance of the former and reducing its overall budget. Since the onset of the crisis, the science budget suffered several cuts, being particularly affected (Fig. 1E). These recent cuts represent the newest signs of

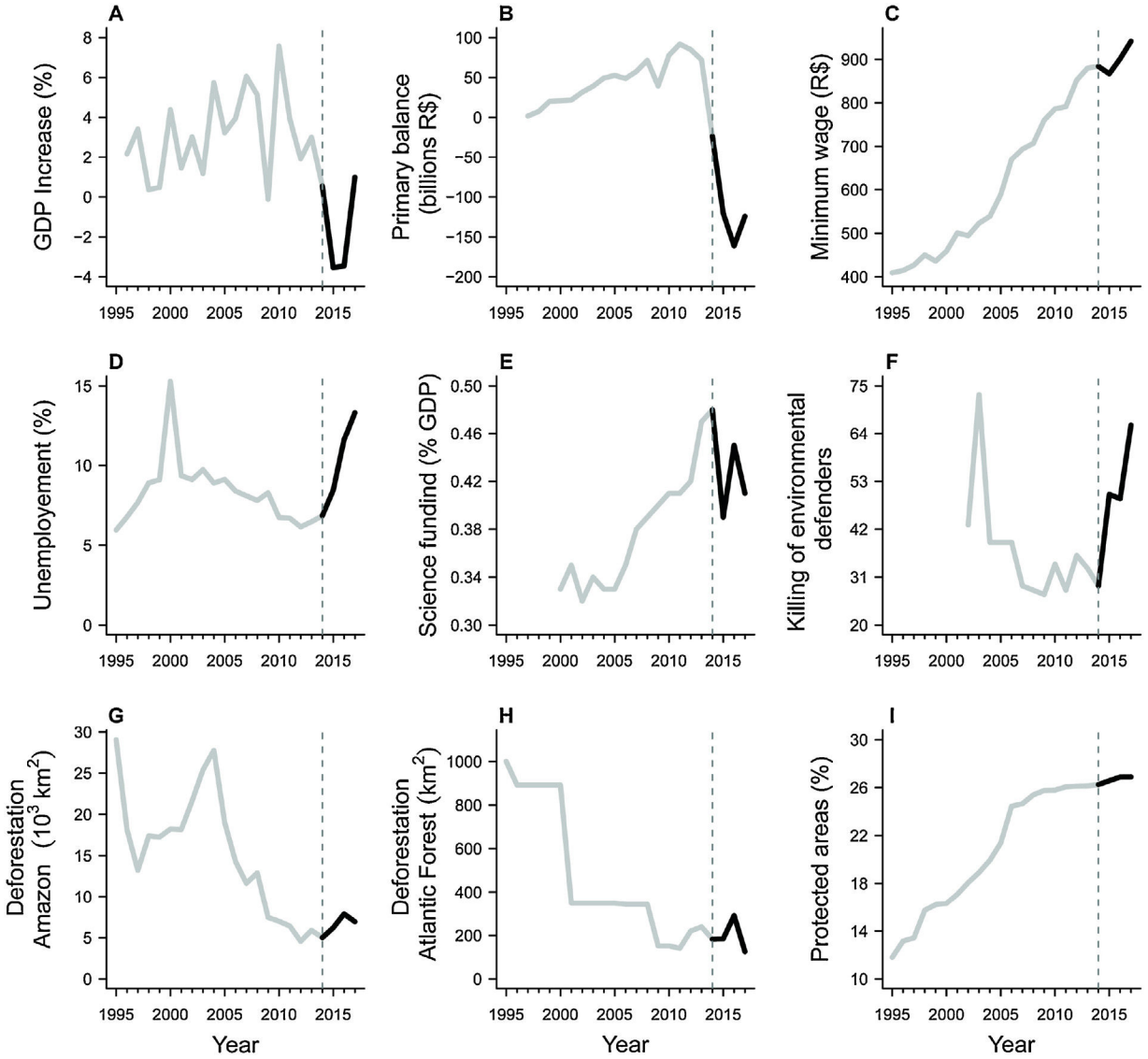

Fig. 1. Socioeconomic and environmental indicators of Brazil's performance. The years before and after the 2014 are shown as gray and black lines, respectively. (A) Annual increase in gross domestic product (GDP). (B) Annual Brazilian Central Government Primary Balance. (C) Minimum wage value, corrected for inflation. (D) Unemployment rate. (E) Investment in science and technology, in relation to GDP. (F) Annual number of land and environmental defenders killed. (G) Annual deforestation of Amazon, in square kilometers. (H) Idem G, for Atlantic Forest. (I) Percentage of Brazilian territory under legal protection.

and older and wide gap between science and policy, particularly on environmental issues (Ferreira et al., 2012). For example, in 2011 the government disregarded researchers' opinion about the building of Belo Monte hydroelectric dam (Regalado, 2011), which is expected to pervasively impact biodiversity and indigenous people, and despite the expected decrease of production (ca. 60%) due to water level seasonal variation. In 2012, the congress approved the Native Vegetation Protection Law (NVPL) of Brazil, which replaced the 1965 Forest Code, weakening environmental protection on private lands and giving amnesties for past offenses (Brancalion et al., 2016). The protected area system, which represents a cornerstone of conservation policy, has been reduced and might lose another of 2.2 million hectares (Bernard et al., 2014). In April, two marine immense protected areas were created with no reference to systematic planning, a core framework for conservation science with Brazilian contributions (e.g. Vilar et al., 2015).

Human rights have been under attack too. Besides the attempt to redefine slavery, operations against slavery were reduced, and more environmental activists are killed in Brazil than in any other country (Global Witness, 2017) (Fig. 1F). Controversial constitutional amendment that limits public spending to inflation for the next 20 years and labor reform which aimed to reduce costs for businesses and give firms more power when negotiating contracts with employees were approved in December 2016 and July 2017, respectively, and pension reform is under discussion.

The growth in gap between science and policy in Brazil has had consequences. November 2015 saw the greatest environment disaster in Brazilian history, when a mine tailing dam collapsed, killing 20 people and suffocating hundreds of kilometers of the Doce ("sweet") River with toxic mud (Garcia et al., 2017). Other 126 mining dams are currently at risk of disruption (Garcia et al., 2017). Every year, in the rainy season, hundreds of people have died in mudslides and flooding because of land-use policies that ignored available knowledge (Brancalion et al., 2016; Lapola et al., 2014). Finally, the rise in destruction of natural vegetation in the last years is expected to cause further losses of biodiversity, ecosystem services and associated economic benefits and human well-being (Fig. 1G and H; Foley et al., 2005). This route impedes Brazilian to meet the sustainable goals agreed in international treaties such as the Aichi Targets of the Convention on Biological Diversity (https://www.cbd.int/); the Paris Agreement on greenhouse gas emissions (https://unfccc.int/process-and-meetings/the-paris-agreement) and the Sustainable Development Goals (https://sustainabledevelopment.un.org/).

Before facing these crises, Brazil had a growing expertise in different fields of science, being in 13th position of the global ranking of scientific production. Brazilian scientists have a prominent role in international research fora as the International Panel on Climate Change (IPCC) or the International Platform on Biodiversity and Ecosystem Services (IPBES). Recently graduated PhDs have been not only publishing in high impact journals, but also helping to build vital biodiversity knowledge (Cardoso et al., 2017), planning conservation and restoration activities (Banks-Leite et al., 2014) and understanding and combating encephalitis associated with the Zika virus outbreak (Araujo et al., 2016). Thus, these examples represent on one hand advances in knowledge with global relevance and on the other hand the foundations for developing evidence-based solutions to sustainability challenges that are specific of Brazilian reality. The expertise needed to address them was built based on the national science and education systems. However, this hard-won heritage is threatened by unsustainable measures and a shift in political focus away from social and environmental demands. The old-fashioned and morally questionable use of economic problems to justify cuts in science budgets and the weakening of the laws protecting biodiversity is not only bad policy, but myopic.

Brazil's years of economic growth and democratic stability, and commitment to investing in overcoming poverty and increasing science and education were highly influential to the world. Many biodiversity-rich countries are building their own pathways to sustainability, including China and African nations (Liu, 2010; Gurib-Fakim, 2017). Brazil holds the world's richest biodiversity, large expanses of poorly explored natural resources (Lapola et al., 2014), and a human richness of tens of thousands of recently graduated people. To accomplish the full potential of these attributes, the country needs democratic stability, political engagement by an educated public, and science-informed policy. Then, Brazil might play again a leading role in devising solutions to current and future social and environmental challenges.

Data accessibility statement

All data supporting this study and their references are provided as supplementary information accompanying this paper. Supplementary data available online with data sources, tables and R-script for figures.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.pecon.2018.06.005.

References

Araujo, T.V., Rodrigues, L.C., de Alencar Ximenes, R.A., de Barros Miranda-Filho, D., Montarroyos, U.R., de Melo, A.P., Valongueiro, S., de Albuquerque, M.F., Souza, W.V., Braga, C., Filho, S.P., Cordeiro, M.T., Vazquez, E., Di Cavalcanti Souza Cruz, D., Henriques, C.M., Bezerra, L.C., da Silva Castanha, P.M., Dhalia, R., Marques-Junior, E.T., Martelli, C.M., Investigators from the Microcephaly Epidemic Research Group, Brazilian Ministry of Health, Pan American Health Organization, Instituto de Medicina Integral Professor Fernando Figueira, State Health Department of Pernambuco, 2016. Association between Zika virus infection and microcephaly in Brazil, January to May, 2016: preliminary report of a case-control study. Lancet Infect. Dis. 16, 1356–1363, http://dx.doi.org/10.1016/S1473-3099(16)30318-8.

Banks-Leite, C., Pardini, R., Tambosi, L.R., Pearse, W.D., Bueno, A.A., Bruscagin, R.T., Condez, T.H., Dixo, M., Igari, A.T., Martensen, A.C., Metzger, J.P., 2014. Using ecological thresholds to evaluate the costs and benefits of set-asides in a biodiversity hotspot. Science 345, 1041–1045, http://dx.doi.org/10.1126/science.1255768.

Bernard, E., Penna, L.A.O., Araújo, E., 2014. Downgrading, downsizing, degazettement, and reclassification of protected areas in Brazil. Conserv. Biol. 28, 939–950, http://dx.doi.org/10.1111/cobi.12298.

Brancalion, P.H., Garcia, L.C., Loyola, R., Rodrigues, R.R., Pillar, V.D., Lewinsohn, T.M., 2016. A critical analysis of the Native Vegetation Protection Law of Brazil (2012): updates and ongoing initiatives. Nat. Conserv. 14, 1–15, http://dx.doi.org/10.1016/j.ncon.2016.03.003.

CGEE (Centro de Gestão e Estudos Estratégicos), 2016. Mestres e doutores 2015–Estudos da demografia da base técnico-científica brasileira. CGEE, Brasília.

Cardoso, D., Särkinen, T., Alexander, S., Amorim, A.M., Bittrich, V., Celis, M., Daly, D., Fiaschi, P., Funk, V.A., Giacomin, L.L., Goldenberg, R., Heiden, G., Iganci, J., Kelloff, C.L., Knapp, S., Lima, H.C., Machado, A.F.P., Santos, R.M., Mello-Silva, R., Michelangeli, F.A., Mitchell, J., Moonlight, P., Moraes, P.L.R., Mori, S.A., Nunes, T.S., Pennington, T.D., Pirani, J.R., Prance, G.T., Queiroz, L.P., Rapini, A., Riina, R., Rincon, C.A.V., Roque, N., Shimizu, G., Sobral, M., Stehmann, J.R., Stevens, W.D.,

Taylor, C.M., Trovó, M., van den Berg, C., vander Werff, H., Viana, P.L., Zartman, C.E., Forzza, R.C., 2017. Amazon plant diversity revealed by a taxonomically verified species list. Proc. Natl. Acad. Sci. U. S. A. 114, 10695–10700, http://dx.doi.org/10.1073/pnas.1706756114.

Dobrovolski, R., Rattis, L., 2015. Water collapse in Brazil: the danger of relying on what you neglect. Nat. Conserv. 1, 80–83, http://dx.doi.org/10.1016/j.ncon.2015.03.006.

Ferreira, J., Pardini, R., Metzger, J.P., Fonseca, C.R., Pompeu, P.S., Sparovek, G., Louzada, J., 2012. Towards environmentally sustainable agriculture in Brazil: challenges and opportunities for applied ecological research. J. Appl. Ecol. 49, 535–541, http://dx.doi.org/10.1111/j.1365-2664.2012.02145.x.

Foley, J.A., DeFries, R., Asner, G.P., Barford, C., Bonan, G., Carpenter, S.R., Chapin, S.F., Coe, M.T., Daily, G.C., Gibbs, H.K., Helkowski, J.H., Holloway, T., Howard, E.A., Kucharik, C.J., Monfreda, C., Patz, J.A., Prentice, I.C., Ramankutty, N., Snyder, P.K., 2005. Global consequences of land use. Science 309, 570–574.

Garcia, L.C., Ribeiro, D.B., Oliveira Roque, F., Ochoa-Quintero, J.M., Laurance, W.F., 2017. Brazil's worst mining disaster: corporations must be compelled to pay the actual environmental costs. Ecol. Appl. 27, 5–9, http://dx.doi.org/10.1002/eap.1461.

Global Witness, 2017. Defenders of the Earth Global Witness. Global Witness, London, https://www.globalwitness.org/en/campaigns/environmental-activists/defenders-earth (accessed 27.03.18).

Gurib-Fakim, A., 2017. Capitalize on African biodiversity. Nature 548, 7, http://dx.doi.org/10.1038/548007a.

IFI–Instituição Fiscal Independente, 2017. Atualização tributária: A influência e impacto das renúncias fiscais. Nota técnica N° 07, http://www2.senado.leg.br/bdsf/bitstream/handle/id/531772/IFI_NT_07_2017-09-14.pdf (accessed 27.03.18).

Lapola, D.M., Martinelli, L.A., Peres, C.A., Ometto, J.P.H.B., Ferreira, M.E., Nobre, C.A., Aguiar, A.P.D., Bustamante, M.M.C., Cardoso, M.F., Costa, M.H., Joly, C.A., Leite, C.C., Moutinho, P., Sampaio, G., Strassburg, B.B.N., Vieira, I.C.G., 2014. Pervasive transition of the Brazilian land-use system. Nat. Climate Change 4, 27–35.

Liu, J., 2010. China's road to sustainability. Science 328, 50, http://dx.doi.org/10.1126/science.1186234.

Londoño, E., 2017, October. President Temer of Brazil dodges corruption prosecution, again. The New York Times, https://nyti.ms/2iyWgZn (accessed 27.03.18).

Prengaman, P., DiLorenzo, S., Trielli, D., https://apnews.com/89afd8d964984eb69678129e7d4a16cc (accessed 27.03.18) 2017, October. Millions Return to Poverty in Brazil, Eroding "Boom" Decade. Associated Press.

Regalado, A., 2011. Brazil gives green light to 'Monster Dam'. Science, http://www.sciencemag.org/news/2011/06/brazil-gives-green-light-monster-dam (accessed 27.03.18).

Vilar, C.C., Joyeux, J.C., Loyola, R., Spach, H.L., 2015. Setting priorities for the conservation of marine vertebrates in Brazilian waters. Ocean Coast. Manage. 107, 28–36, http://dx.doi.org/10.1016/j.ocecoaman.2015.01.018.

Watts, J., 2016, August. Dilma Rousseff impeachment: what you need to know – the Guardian briefing. The Guardian, https://www.theguardian.com/news/2016/aug/31/dilma-rousseff-impeachment-brazil-what-you-need-to-know (accessed 27.03.18).