TRADE, DEVELOPMENT & THE ENVIRONMENT HUB

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TRANSFORMATIVE TRADE

THREE GUIDING PRINCIPLES FOR INDUCING POSITIVE CHANGE TOWARDS SUSTAINABILITY

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KEY MESSAGES AND POLICY RECOMMENDATIONS

1. Large-scale commodity trade from Global South producing countries to Global North consumer countries induces deep negative impacts on society and environment due to deforestation and conversion of natural ecosystems into agriculture oriented for exports.
2. Main negative impacts are (a) emissions of greenhouse gases, (b) disruption of water availability, (c) threats to biodiversity, (d) land grabbing and concentration, (e) displacement of indigenous peoples and traditional communities, (f) impairment of food security at local and global levels. These impacts are widely-acknowledged in scientific literature (see references list) and they are severe not only in forested environments, but in all ecosystems. Grasslands and other wooded lands, for instance, are an example of ecosystems which are under-protected in national legislation and face high pressure from agricultural expansion, mainly to meet the international commodity demand from industrialized regions such as Europe, the United States, and China.
3. However, international trade also has the potential to foster positive impacts. It can trigger transformations towards sustainability by halting the incentives for deforestation and conversion of natural ecosystems and respecting the rights of local communities to ensure diversified and healthy food production, a more responsible use of already clear-cut lands and fair supply chains.
4. To do so, **three main aspects** should be incorporated as guiding principles for decision-making on trade-related regulations at the national, regional and international scales for fostering such positive transformations: (i) adopt criteria on zero conversion of natural ecosystems, (ii) adopt meaningful criteria and implementation tools to ensure the respect for human rights (based on national and international protective laws, such as the ILO 169 and the Universal Declaration on Human Rights), (iii) implement transparent mechanisms based on geolocation of the production site[1] to ensure full traceability and accountability, reporting compliance measures through due diligence statements and periodic public reports.

[1] Production site corresponds to a spatially defined area where a commodity or a product are produced. These sites should be monitored through geospatial polygons that represent either contiguous or adjacent areas used by the same owner or partners to carry out production activities, regardless of any administrative subdivisions applied.

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INTRODUCTION: WE ARE INTERCONNECTED

The Covid pandemic has pointed out the stark interconnection of human actions, showing that local actions have concrete consequences at a local as much as at a global level (Brancalion *et al.*, 2020). The awareness that **our behaviors in one place have far-reaching effects in other distant parts of the world** provide us with the opportunity to rethink our choices (Castro *et al.*, 2020). It is a way to forge a new approach to common problems and promote positive transformations and foster greater cooperation towards sustainability.

A key element of this **interconnection is international trade, which is the link between consumer markets and quite distant producing regions** (Meyfroidt *et al.*, 2013). This commercialization drives the expansion of agricultural commodities, and the relation between these two processes is a fundamental driver of deforestation and conversion of natural ecosystems worldwide as well as an inducer of the associated socioenvironmental degradation in producing regions (Curtis *et al.*, 2018). This is especially acute in the trade flows between commodity-producing countries in the Global South and commodity-consumer countries in the Global North (Hong *et al.*, 2022). At present, the global economic system based on international commodity trade, allows consumer countries to regenerate and restore their native vegetation by outsourcing their commodity production – and consequent socioenvironmental impacts – to other regions of the world (Yao *et al.*, 2018). By doing so, it makes these commercial relationships opaque and dissociated from bold sustainability standards (Gardner *et al.*, 2019).

In recent years, however, **public opinion has become increasingly aware that the way we produce and consume our food is directly connected to negative impacts** such as deforestation, biodiversity loss, climate change and violation of human rights (Wiedmann & Lenzen, 2018). As much as trade and consumption have been directly driving negative impacts in producing regions (Sun *et al.*, 2017), **it can also foster fairer trade relations** (Venkatesan, 2021). With adequate policies, regulations and incentives, trade can support human rights for traditional populations and small-scale producers, strengthen the sociobiodiversity economy which contributes to food security, and induce regenerative transformations in all types of natural environments in the sourcing areas. The purpose of this policy brief is to summarize the scientific studies on the linked social andenvironmental impacts of commodity supply-chains and to provide inputs for policymakers to shape transformative trade relations that can induce sustainability rather than deforestation.

THE CURRENT TRADE PATTERN: NEGATIVE IMPACTS

Large-scale commodity trade is currently structured in a way that seeks to increase production and consumption while reducing the costs (Naylor *et al.*, 2005). Under this paradigm, international trade results in multiple negative socioenvironmental impacts stemming from deforestation and conversion of natural ecosystems driven by commodity expansion (Yao *et al.*, 2018). Table 1 summarizes these current negative impacts.

Table 1. Summary of negative impacts of land-use change driven by international trade.

Socio-Environmental Negative Impacts					
GHG Emissions	Water Cycle Disruption	Biodiversity Threats	Land Grabbing and Concentration	Displacement of Local Communities	Impairment of Food Security

GREENHOUSE GASES EMISSIONS

International trade of commodity drives large-scale deforestation and conversion of natural ecosystems in the producing regions (Reis *et al.*, 2021). The clear-cut of long-standing forests emits significant amounts of CO_2, as well as the conversion of other ecosystems such as grasslands, woodlands and wetlands (see Russo *et al.*, 2018). The world's 'land-use emissions', which encompass both land-use change and the land management of the areas converted to agriculture, have been increasing since the 2000s and accounted for about 25% of all anthropogenic GHG emissions in 2017 (Hong *et al.*, 2022). Moreover, the distribution of these emissions is highly disproportionate; for example, "emissions for beef and other red meats supply only 1 per cent of calories worldwide, but account for 25 per cent of all land-use emissions" (Hong *et al.*, 2021).

DISRUPTION OF WATER AVAILABILITY

Large-scale agriculture leads to substantial impacts on the water cycle due to the removal of natural ecosystems. Without native vegetation, the evapotranspiration of trees is disrupted, which decreases the levels of moisture in the atmosphere and, consequently, rainfall patterns (Spera *et al.*, 2016). The lack of native vegetation associated with expansion of monocultures further impairs the infiltration of water from rainfall into the soil to recharge the groundwater reservoirs, further disrupting the water cycle (Carvalho *et al.*, 2009; Oliveira *et al.*, 2014). Another impact on water availability is the expansion of irrigation systems, which increases the pressure on local rivers and oftentimes leads to their disappearance (Pousa *et al.*, 2019). Moreover, export-oriented agriculture is highly intensive in the use of agrochemicals, which contaminates rivers and aquifers (Albuquerque *et al.*, 2016), harming the overall health of local communities (Rigotto *et al.*, 2014) and hindering their access to clean water (Russo Lopes *et al.*, 2021).

THREATS TO BIODIVERSITY

A significant impact of export-oriented commodities is the loss of biodiversity resulting from the destruction of natural habitats, which includes forest, grasslands, woodlands, wetlands, and other ecosystems (Strassbourg *et al.*, 2017). The damage caused by deforestation and conversion of native vegetation has been pressuring rainforests like the Amazon into tipping points in which the provision of ecosystem services is severely impaired (Lovejoy & Nobre, 2018).

Consequently, more than three-quarters of the Amazon rainforest has been losing resilience during the past two decades (Boulton *et al.*, 2022). Biodiversity levels have also been substantially threatened by illegal hunting of wildlife species (Chaves *et al.*, 2021), that contributes to the current dynamics of international trade, further impacting human health as in the example of the Covid-19 pandemic (Brancalion *et al.*, 2020).

LAND GRABBING AND CONCENTRATION

The way large-scale commodity advances is vastly based on the conversion of native vegetation into agricultural lands (Hong *et al.*, 2022). This is true for the Amazon, which has lost almost 250.000 km2 since 2001 (6 times the size of the Netherlands), but also for other key ecosystems, such as the Cerrado savanna, which has lost almost 290.000 km² in the same period (7 times the size of the Netherlands) (INPE, 2022).

The process of expansion over native vegetation comes associated with a steep increase in land prices, particularly in frontier regions (Flexor & Leite, 2017), largely due to land grabbing and land speculation (Spadotto *et al.*, 2021) often through illegal practices (Campbell *et al.*, 2015). This results in concentrating land in the hand of few actors[2], deepening inequality in those regions (Pinto *et al.*, 2020).

[2] According to Pinto *et al.* (2020), "A quarter (25%) of all agricultural land in Brazil is occupied by the 15.686 largest properties in the country (0.3% of total properties) which are mainly concentrated in Mato Grosso, Mato Grosso do Sul and Matopiba. To reach the other 25% of the total area, it is necessary to add the areas of the 3.847.937 smaller ones (77% of the total properties), with the largest presence of these small properties in the South, Southeast and Northeast regions."

DISPLACEMENT OF INDIGENOUS PEOPLES AND TRADITIONAL COMMUNITIES

The rush to grab land is aimed at clearing these areas and selling for a speculative price for large-scale agricultural production (mainly cattle-ranching, followed by soy in frontier regions) (Favareto, 2019). The result is a hike in deforestation and conversion pressures which often leads to violation of land rights, such as the displacement of local communities (Anaya & Espírito-Santo, 2018), the invasion of indigenous lands (Ferrante & Fearnside, 2020) and a hike in violent rural conflicts (CPT, 2021). Although indigenous peoples and local communities often engage in social movements and campaigns to protect their territorial rights (see APIB, 2019), the profitability of deforestation and conversion of native vegetation and the feeling of impunity remain fundamental drivers on the attempt to grab and invade their lands.

IMPAIRMENT OF FOOD SECURITY AT LOCAL AND GLOBAL LEVELS

Oftentimes, the negative socio-environmental impacts of commodity production are justified in the mass media through the argument of promoting development, economic growth, and food security to the producing regions and to the world (Russo Lopes *et al.*, 2021). Nevertheless, this discourse is not matching these regions' realities, where the most common outcome of export-oriented industrial agriculture is poverty rather than well-being (Favareto *et al.*, 2019). Moreover, while major part of large-scale grains production (~80%) is used as animal feed and in industrial processes (Ritchie & Roser, 2021), the agricultural yield from smallholders and traditional communities is more diverse (Badstue *et al.*, 2005), more productive and resource-conserving (Altieri, 2008) and, consequently, more crucial for human consumption and food security (FAO, 2017).

THE POTENTIAL FOR CHANGE: TRADE DRIVING POSITIVE TRANSFORMATIONS

Due to the negative socio-environmental impacts, international trade of large-scale commodities has been accelerating climate change and social inequalities. **Yet, trade can also be reshaped to drive transformative change towards sustainability. This entails ensuring the respect for human rights, supporting diversified and deforestation-free agricultural production from local communities and tackling environmental issues, such as climate change, biodiversity loss and disruptions in water cycle.**

A straightforward pathway to do so is to halt deforestation and conversion of natural habitats, not only in forests but in all ecosystems around the world like the Americas´ natural grassland and other wooded land (Pötzschner *et al.*, 2022).Those are poorly protected and under high pressure from agricultural expansion, mainly to meet the international demand in commodities to more industrialized regions such as Europe, the United States, and China (Hong *et al.*, 2022). A shift in production and consumption standards has the potential to – through one single policy decision – empower indigenous peoples and traditional populations, foster healthy and diversified food production from smallholders (Laroche *et al.*, 2020) and enhance food security worldwide through a better use of already cleared lands (Hong *et al.*, 2021). Local communities and traditional populations have productive systems which are substantially less reliant on agrochemicals; more varied in terms of agricultural outputs, producing food that will be directly consumed by people

rather than commodities used as inputs for other industries; due to their small scale, these productive systems are also more environmentally sound, for they make use of natural materials, are not intensive on irrigation, entails a redistributive approach to land as well as the income generated by agricultural production and oftentimes co-exist with native forests and/or regenerate degraded landscapes through agroforestry systems (see Russo Lopes *et al.*, 2021 for a case-study on the Brazilian Cerrado).

To achieve such positive transformations, it is fundamental that regulations that steer global trade, were they adopted at national, regional or international level, are guided by ambitious and explicit sustainability criteria (Kehoe *et al.*, 2020). It is equally important that these regulations are based on transparent and well-defined goals for sustainability and a timeframe for their implementation, such as the guidelines proposed by Accountability Framework initiative[3].

A political commitment to halt environmental degradation driven by agricultural trade can bring about socioenvironmental integrity in both producing and consuming countries (Bager *et al.*, 2021). Therefore, increasing the visibility of economic, political and cultural costs of deforestation and the conversion of natural ecosystems will be a turning point for deforestation-intensive productive systems – and incentivize more inclusive, regenerative and reliable agricultural production systems based on nature conservation and better health and socioenvironmental standards.

To do so, trade-related regulations should be guided by and aim to integrate three equally important actions:

- Be guided by the environmental criteria of **zero conversion of natural ecosystems**, including forests, but also other wooded lands and natural grasslands, where so much commodity production takes place.
- Integrate the social criteria of **respect for human rights** and land rights for traditional territories.
- Be supported by **transparent geolocation-based mechanisms** that trace the implementation of the social-environmental criteria up to the production site level, reporting the actions taken to ensure compliance publicly and periodically.

In doing so, trade regulations will not only mitigate its negative effects, but also actively induce positive change and sustain a more equitable production and commercialization system globally.

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[3] "The Accountability Framework initiative (AFi) is a collaborative effort to build and scale up ethical supply chains for agricultural and forestry products led by a diverse global coalition of environmental and human rights organizations". See: https://accountability-framework.org/.

REFERENCES

Albuquerque, A. F., Ribeiro, J. S., Kummrow, F., Nogueira, A. J. A., Montagner, C. C., & Umbuzeiro, G. A. (2016). Pesticides in Brazilian freshwaters: a critical review. *Environmental Science: Processes & Impacts*, 18(7), 779-787.

Altieri, M. A. (2008). *Small farms as a planetary ecological asset: five key reasons why we should support the revitalisation of small farms in the global south* (Vol. 7). Penang, Malaysia: Third World Network.

Anaya, F. C., & Espírito-Santo, M. M. (2018). Protected areas and territorial exclusion of traditional communities. *Ecology and Society*, 23(1).

APIB. (2019). *Campaign "Indigenous Blood: Not a Single Drop More"*. Brasília: Associação dos Povos Indígenas do Brasil. Available at: https://apiboficial.org/2019/10/23/letter-from-indigenous-blood-not-a-single-drop-more-to-pope-francisco/.

Badstue, L. B., Bellon, M. R., Berthaud, B., Ramírez, A., Flores, D., Juárez, X., & Ramírez, F. (2005). *Collective action for the conservation of on-farm genetic diversity in a center of crop diversity: an assessment of the role of traditional farmers' networks*. Washington, DC: International Food Policy Research Institute. Available at: https://ebrary.ifpri.org/utils/getfile/collection/p15738coll2/id/125190/filename/125191.pdf .

Bager, S.L., Persson, U.M., dos Reis, T.N.P. (2021). Eighty-six EU policy options for reducing imported deforestation. *One Earth* 4:289–306, https://doi.org/10.1016/j.oneear.2021.01.011

Boulton, C.A., Lenton, T.M. & Boers, N. (2022). Pronounced loss of Amazon rainforest resilience since the early 2000s. *Nat. Clim. Chang.* 12:271–278, https://doi.org/10.1038/s41558-022-01287-8

Brancalion, P. H., Broadbent, E. N., De-Miguel, S., Cardil, A., Rosa, M. R., Almeida, C. T., ... & Almeyda-Zambrano, A. M. (2020). Emerging threats linking tropical deforestation and the COVID-19 pandemic. *Perspectives in ecology and conservation*, 18(4):243-246.

Campbell, J. M. (2015). *Conjuring property: Speculation and environmental futures in the Brazilian Amazon*. Washington, US: University Press.

Carvalho, J. L. N., Cerri, C. E. P., Feigl, B. J., Piccolo, M. D. C., Godinho, V. P., & Cerri, C. C. (2009). Carbon sequestration in agricultural soils in the Cerrado region of the Brazilian Amazon. *Soil and Tillage Research*, 103(2):342-349.

Castro, F., Russo Lopes, G., & Brondizio, E. (2020). The Brazilian Amazon in Times of COVID-19: from crisis to transformation? *Ambiente & Sociedade*, 23:1-11.

Chaves, W. A., Valle, D., Tavares, A. S., von Mühlen, E. M., & Wilcove, D. S. (2021). Investigating illegal activities that affect biodiversity: the case of wildlife consumption in the Brazilian Amazon. *Ecological Applications*, 31(7), e02402.

CPT. (2021). *Conflitos no Campo Brasil*. Goiânia: Comissão Pastoral da Terra. Available at: https://www.cptnacional.org.br/publicacoes-2/destaque/6001-conflitos-no-campo-brasil-2021.

Curtis, P. G., Slay, C. M., Harris, N. L., Tyukavina, A., & Hansen, M. C. (2018). Classifying drivers of global forest loss. *Science*, 361(6407):1108-1111.

FAO. (2017). *The state of food and agriculture*. Rome: Food and Agriculture Organization of the United Nations. Available at: http://uni-sz.bg/truni11/wp-content/uploads/biblioteka/file/TUNI10042440(1).pdf

Favareto, A (Coord). (2019). *Entre chapadas e baixões do Matopiba: dinâmicas territoriais e impactos socioeconômicos da expansão agropecuária no Cerrado*. São Paulo: Prefixo Editorial. Available at: https://storage.googleapis.com/planet4-brasil-stateless/2019/05/49824d91-entre-chapadas-e-baixões-do-matopiba_versão-ebook.pdf.

Favareto, A., Nakagawa, L., Kleeb, S., Seifer, P., & Pó, M. (2019). There is more poverty and inequality than well-being and wealth in the municipalities of Matopiba. *Revista Nera*, (47):348-381.

Ferrante, L., & Fearnside, P. M. (2020). Brazil threatens Indigenous lands. *Science*, 368(6490):481-482.

Flexor, G., & Leite, S. P. (2017). Land market and land grabbing in Brazil during the commodity boom of the 2000s. *Contexto Internacional*, 39 :393-420.

Gardner, TAA, Benzie, M., Börner, J., Dawkins, E., Fick, S., Garrett, R., Godar, J., Grimard, A., Lake, S., Larsen, RKK, Mardas, N., McDermott, CLL, Meyfroidt, P., Osbeck, M., Persson, M., Sembres, T., Suavet, C., Strassburg, B., Trevisan, A., West, C., Wolvekamp, P. (2019). Transparency and sustainability in global commodity supply chains. *World Development*, 121:163–177, https://doi.org/10.1016/j.worlddev.2018.05.025

Hong, C., Burney, J.A., Pongratz, J. *et al*. Global and regional drivers of land-use emissions in 1961–2017. (2021) *Nature*, 554–561, https://doi.org/10.1038/s41586-020-03138-y

Hong, C., Zhao, H., Qin, Y., Burney, J.A., Pongratz, J., Hartung, K., Liu, Y., Moore, F.C., Jackson, R.B., Zhang, Q. and Davis, S.J. (2022). Land-use emissions embodied in international trade. *Science*, 376(6593):597-603.

INPE. (2022). *Terra Brasilis: Prodes (Desmatamento)*. Brasília: Instituto Nacional de Pesquisas Espaciais. Available at: http://terrabrasilis.dpi.inpe.br/app/map/deforestation?hl=pt-br.

Kehoe, L., Reis, TNP, Meyfroidt, P., Bager, S., Seppelt, R., Kuemmerle, T., Berenguer, E., Clark, M., Davis, KF, Ermgassen, EKHJ, Farrell, KN , Friis, C., Haberl, H., Kastner, T., Murtough, KL, Persson, UM, Connell, CO, Valeska, V., Romero-mun, A. (2020). Inclusion, Transparency, and Enforcement: How the EU-Mercosur Trade Agreement Fails the Sustainability Test - Commentary. *One Earth*, https://doi.org/10.1016/j.oneear.2020.08.013

Laroche, P. C., Schulp, C. J., Kastner, T., & Verburg, P. H. (2020). Telecoupled environmental impacts of current and alternative Western diets. *Global Environmental Change*, 62:102066.

Lovejoy, T. & Nobre, C. (2018). Amazon Tipping Point. *Science Advances*, 4, 10.1126/sciadv.aat2340.

Magliocca, NR, Ellis, EC, Allington, GRH, of Bremond, A., Dell'Angelo, J., Mertz, O., Messerli, P., Meyfroidt, P., Seppelt, R., Verburg, PH, 2018 Closing global knowledge gaps: Producing generalized knowledge from case studies of social-ecological systems. *Global Environmental Change*. 50, 1–14, https://doi.org/10.1016/j.gloenvcha.2018.03.003.

Meyfroidt, P., Lambin, E. F., Erb, K. H., & Hertel, T. W. (2013). Globalization of land use: distant drivers of land change and geographic displacement of land use. Current Opinion in *Environmental Sustainability*, 5(5):438-444.

Naylor, R., Steinfeld, H., Falcon, W., Galloway, J., Smil, V., Bradford, E., ... & Mooney, H. (2005). Losing the links between livestock and land. *Science*, 310(5754):1621-1622.

Oliveira, P. T. S., Nearing, M. A., Moran, M. S., Goodrich, D. C., Wendland, E., & Gupta, H. V. (2014). Trends in water balance components across the Brazilian Cerrado. *Water Resources Research*, 50(9):7100-7114.

Pinto, L., de Faria, V., Sparovek, G., Reydon, B., Ramos, C., Siqueira, G., Godar, J., Gardner, T., Rajão, R., Alencar, A., Carvalho, T., Cerignoni, F., Granero, I., Couto, M (2020) Quem São Os Poucos Donos Das Terras Agrícolas No Bras–l - O Mapa Da Desigualdade. *Sustentabilidade em Debate*, 10:1-21.

Pötzschner, F., Baumann, M., Gasparri, N. I., Conti, G., Loto, D., Piquer-Rodríguez, M., & Kuemmerle, T. (2022). Ecoregion-wide, multi-sensor biomass mapping highlights a major underestimation of dry forests carbon stocks. *Remote Sensing of Environment*, 269, 112849. doi:10.1016/j.rse.2021.112849

Pousa, R., Costa, M. H., Pimenta, F. M., Fontes, V. C., Brito, V. F. A. D., & Castro, M. (2019). Climate change and intense irrigation growth in Western Bahia, Brazil: The urgent need for hydroclimatic monitoring. *Water*, 11(5):933.

Reis, T. N., de Faria, V. G., Russo Lopes, G. R., Sparovek, G., West, C., Rajão, R., Ferreira, M., Elvira, M., & do Valle, R. S. (2021). Trading deforestation—why the legality of forest-risk commodities is insufficient. *Environmental Research Letters*, 16(12):124025.

Rigotto, R. M., Vasconcelos, D. P., & Rocha, M. M. (2014). Pesticide use in Brazil and problems for public health. *Cadernos de Saúde Pública*, 30, 1360-1362.

Ringler, C., Bhaduri, A., Lawford, R., 2013. The nexus across water, energy, land and food (WELF): Potential for improved resource use efficiency? *Current Opinion Environmental Sustainability*. 5:617-624, https://doi.org/10.1016/j.cosust.2013.11.002.

Ritchie, H., & Roser, M. (2021) *Forests and Deforestation*. Oxford: University Press. Available at: https://ourworldindata.org/forests-and-deforestation.

Russo Lopes, G., Bastos-Lima, M., & dos Reis, T.P.N. (2021). Maldevelopment revisited: Inclusiveness and social impacts of soy expansion over Brazil's Cerrado in Matopiba. *World Development*, 139:105316, https://doi.org/10.1016/j.worlddev.2020.105316.

Russo, G., Alencar, A., Ribeiro, V., Amorim, C., Shimbo, J., Lenti, F., & Castro, I. (2018). *Cerrado: The Brazilian savanna's contribution to GHG emissions and to climate solutions*. Brasília: Amazon Environmental Research Institute. Available at: https://ipam.org.br/wp-content/uploads/2018/12/Policy-Brief-Cerrado-COP24-en-1.pdf.

Schröter, M., Koellner, T., Alkemade, R., Arnhold, S., Bagstad, KJ, Erb, KH, Frank, K., Kastner, T., Kissinger, M., Liu, J., López- Hoffman, L., Maes, J., Marques, A., Martín-López, B., Meyer, C., Schulp, CJE, Thober, J., Wolff, S., Bonn, A. (2018). Interregional flows of ecosystem services: Concepts, typology and four cases. *Ecosystem Service*, 1–11, https://doi.org/10.1016/j.ecoser.2018.02.003.

Spadotto, B. R., Martenauer Saweljew, Y., Frederico, S., & Teixeira Pitta, F. (2021). Unpacking the finance-farmland nexus: circles of cooperation and intermediaries in Brazil. *Globalizations*, 18(3):461-481.

Spera, S. A., Galford, G. L., Coe, M. T., Macedo, M. N., & Mustard, J. F. (2016). Land- use change affects water recycling in Brazil's last agricultural frontier. *Global Change Biology*, 22(10):3405-3413.

Strassburg, B., Brooks, T., Feltran-Barbieri, R., Iribarrem, A., Crouzeilles, R., Loyola, R., Latawiec, E., Filho, F., Scaramuzza, C., Scarano, F., Soares-Filho, B., & Balmford, A. (2017). Moment of truth for the Cerrado. *Nature Ecology & Evolution*, 1(99): 1–3, 10.1038/s41559-017-0099.

Sun, J., Tong, Y. xin, Liu, J., 2017. Telecoupled land-use changes in distant countries. J. Integral Agricultural 16:368–376. https://doi.org/10.1016/S2095-3119(16)61528-9

Venkatesan, M. (2021). *The Role of Culture and Moral Responsibility in Facilitating a Sustainable Bioeconomy*. In: Venkatramanan V., Shah S., Prasad R. (eds) Sustainable Bioeconomy. Singapore: Springer. https://doi.org/10.1007/978-981-15-7321-7_2.

Wiedmann, T., Lenzen, M. (2018). Environmental and social footprints of international trade. Nat. Geosci. 11, 314–321. https://doi.org/10.1038/s41561-018-0113-9

Wood, S.A., Smith, M.R., Fanzo, J., Remans, R., Defries, R.S., (2018). *Nature Sustainability*. 1, 34–37. https://doi.org/10.1038/s41893-017-0008-6

Yao, G., Hertel, T.W., Taheripour, F. (2018). Economic drivers of telecoupling and terrestrial carbon fluxes in the global soybean complex. *Global Environmental Change*, 50:190–200, https://doi.org/10.1016/j.gloenvcha.2018.04.005.

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