Economic Drivers of Deforestation in the Brazilian Legal Amazon

Eduardo Haddad

Professor of Economics, University of São Paulo, Brazil

(with I. F. Araújo, R. Feltran-Barbieri, F. S. Perobelli, A. Rocha, K. S. Sass, C. A. Nobre)

Background

Economic drivers of deforestation in the Brazilian Legal Amazon

Eduardo A. Haddad [1,2,3] ✉, Inácio F. Araújo [1,3], Rafael Feltran-Barbieri[4], Fernando S. Perobelli [5], Ademir Rocha [1,3], Karina S. Sass[3] & Carlos A. Nobre[6]

Background

nature

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RESEARCH HIGHLIGHT | 02 July 2024

The surprising driver of Amazon deforestation

Demand from Brazil itself accounts for more than half of the demand for crops and livestock from the Amazon and the savannah that surrounds it.

SEPTEMBER 20, 2024

✓ Editors' notes

Deforestation in the Amazon is driven more by domestic demand than by the export market, finds study

by FAPESP

Gianmarco Pondrano d'Altavilla

agrifood | Enea Rassegna | Natura, biodiversità, agrifood | News | Transizione ecologica

LA DEFORESTAZIONE IN AMAZZONIA È GUIDATA IN PREVALENZA DALLA DOMANDA INTERNA

(23 SETTEMBRE 2024)

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Study shows most Amazon beef & soy demand comes from Brazil — not exports

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Apesar da demanda estrangeira por commodities, quase 60% do desmatamento da Amazônia vem do mercado doméstico

By **DA REDAÇÃO** · 22 de julho de 2024 | 12h00

Science   21 SEP 2024 12:50 AM AEST

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Domestic Demand Fuels Amazon Deforestation More Than Exports

NOTICIAS

Cómo el consumo en Brasil afecta la deforestación en la Amazonía

By Leonardo Vargas - 5 August 2024   👁 60   💬 0

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NATUREZA E MEIO AMBIENTE | BRASIL

Como o consumo no Brasil afeta o desmatamento da Amazônia

Mauricio Frighetto
05/08/2024

Estudo revela que a demanda por produtos agropecuários, especialmente a carne consumida no Centro-Sul, é a principal causa do desflorestamento – superando até mesmo a exportação de commodities.

FOLHA DE S.PAULO
★ ★ ★

Desmatamento da amazônia é mais impactado por consumo do Brasil que por exportações

Estudo da USP mostra que expansão da pecuária, pressionada por demanda interna, foi o fator que mais contribuiu para derrubada da floresta

Background

The Legal Amazon (LAM) is a **legal delimitation** that includes the entirety of the Brazilian Amazon Basin, encompassing the tropical forest and adjacent Cerrado areas.

It amounts to 5 Mkm2 (roughly half the size of Canada) – **59% of the Brazilian territory**.

With about **28 million inhabitants** and an average Human Development Index below 0.58, it fully covers the states of Acre, Amazonas, Amapá, Pará, Rondônia, Tocantins and Mato Grosso, in addition to part of Maranhão.

Issues

Accountability for the pressure on the use of the world's natural resources

In the case of the Brazilian Amazon, local deforestation is often closely tied to the structure of the global economy.

Here we show that economic demand originating in the more developed Brazilian center-south imposes a much stronger pressure on Amazon's deforestation than local (within Amazon) and foreign export demand.
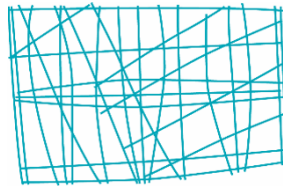
Deforestation monitor
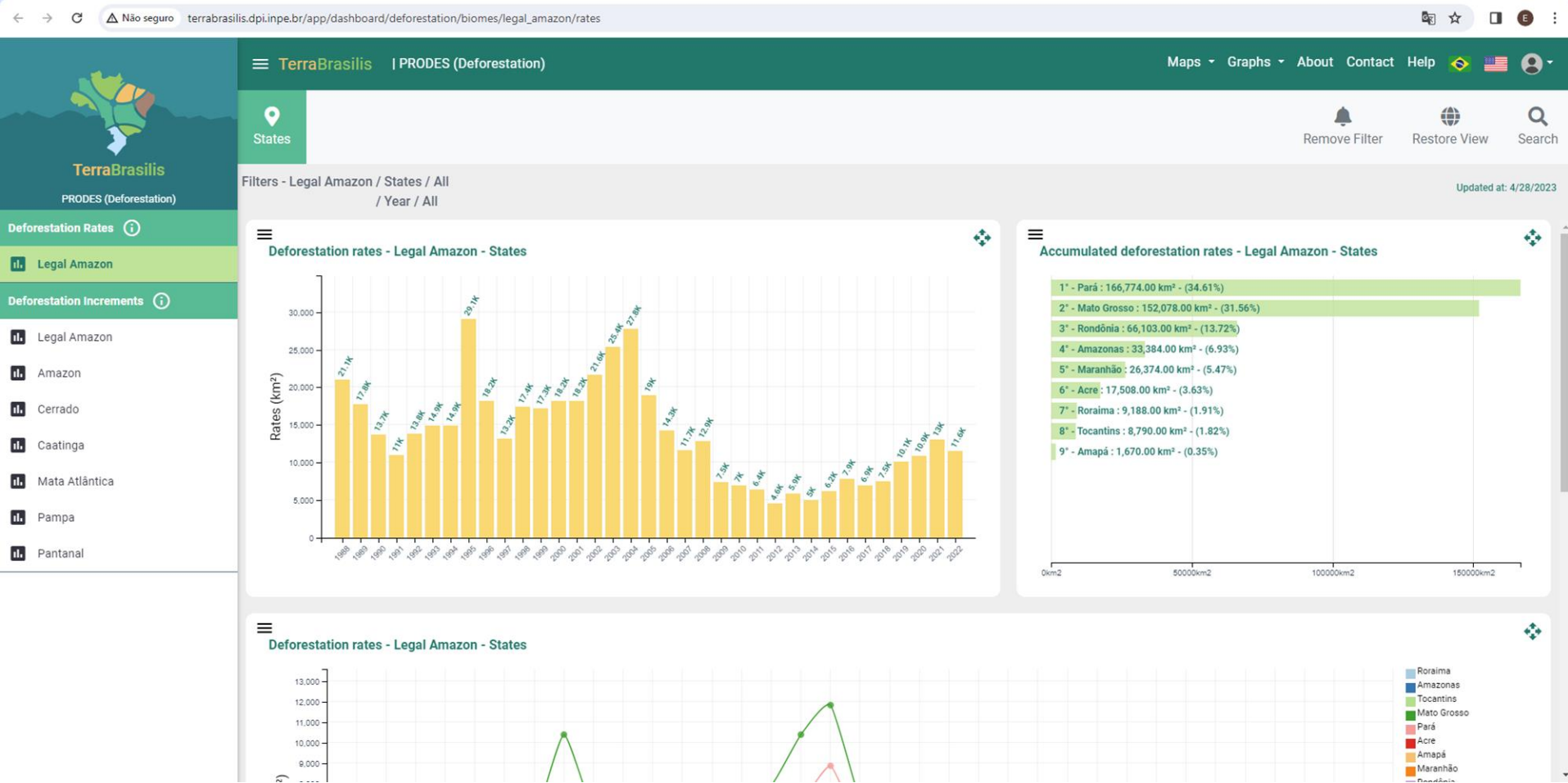
Deforestation and CO2 emissions
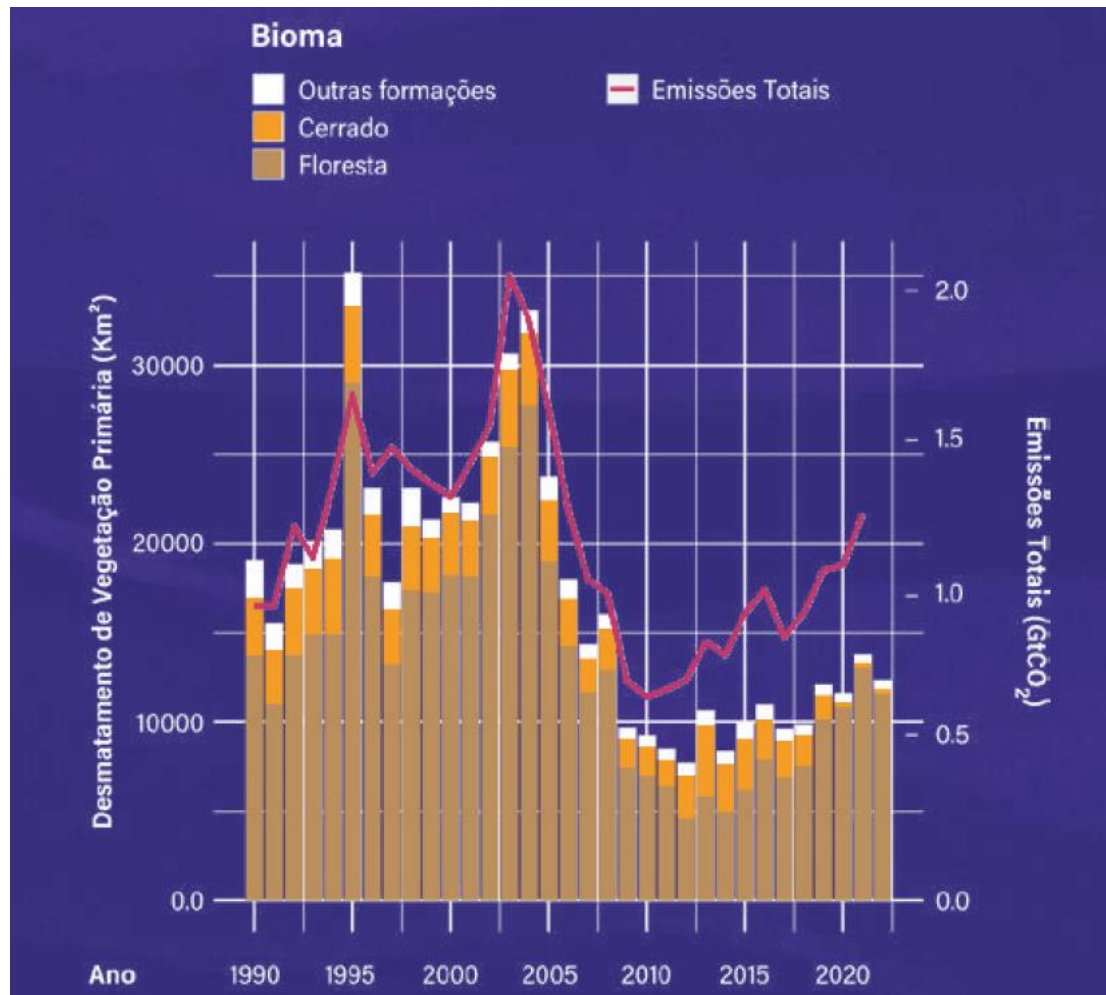
Inter-Regional Input-Output Matrix (IIOM-LAM)

Matriz Inter-regional de Insumo-Produto para a Amazônia

<u>Referência:</u> Haddad, E. A. (coord.) (2021). *Matriz Inter-regional de Insumo-Produto para a Amazônia Legal, 2015* . Fundação Instituto de Pesquisas Econômicas.

<u>Equipe Técnica:</u>
Eduardo Amaral Haddad (coord.)
Ademir Antônio Moreira Rocha
Fernando Salgueiro Perobelli
Inácio Fernandes de Araújo Junior
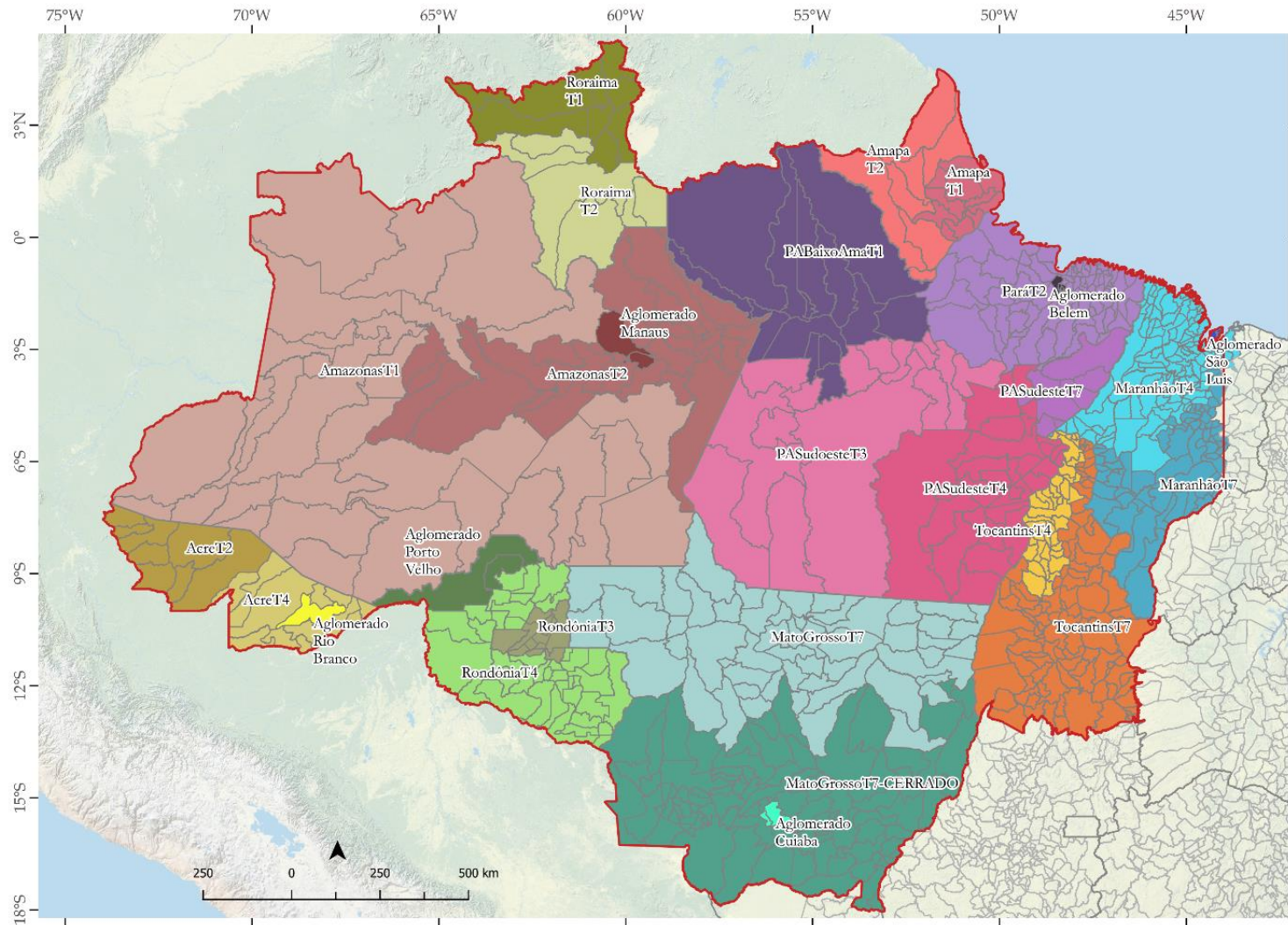Karina Simone Sass
Rafael Feltran-Barbieri

https://www.wribrasil.org.br/nova-economia-da-amazonia

International versus interregional trade

Table 1. The Prevalence of International and Interregional Trade in the Brazilian Legal Amazon (LAM)

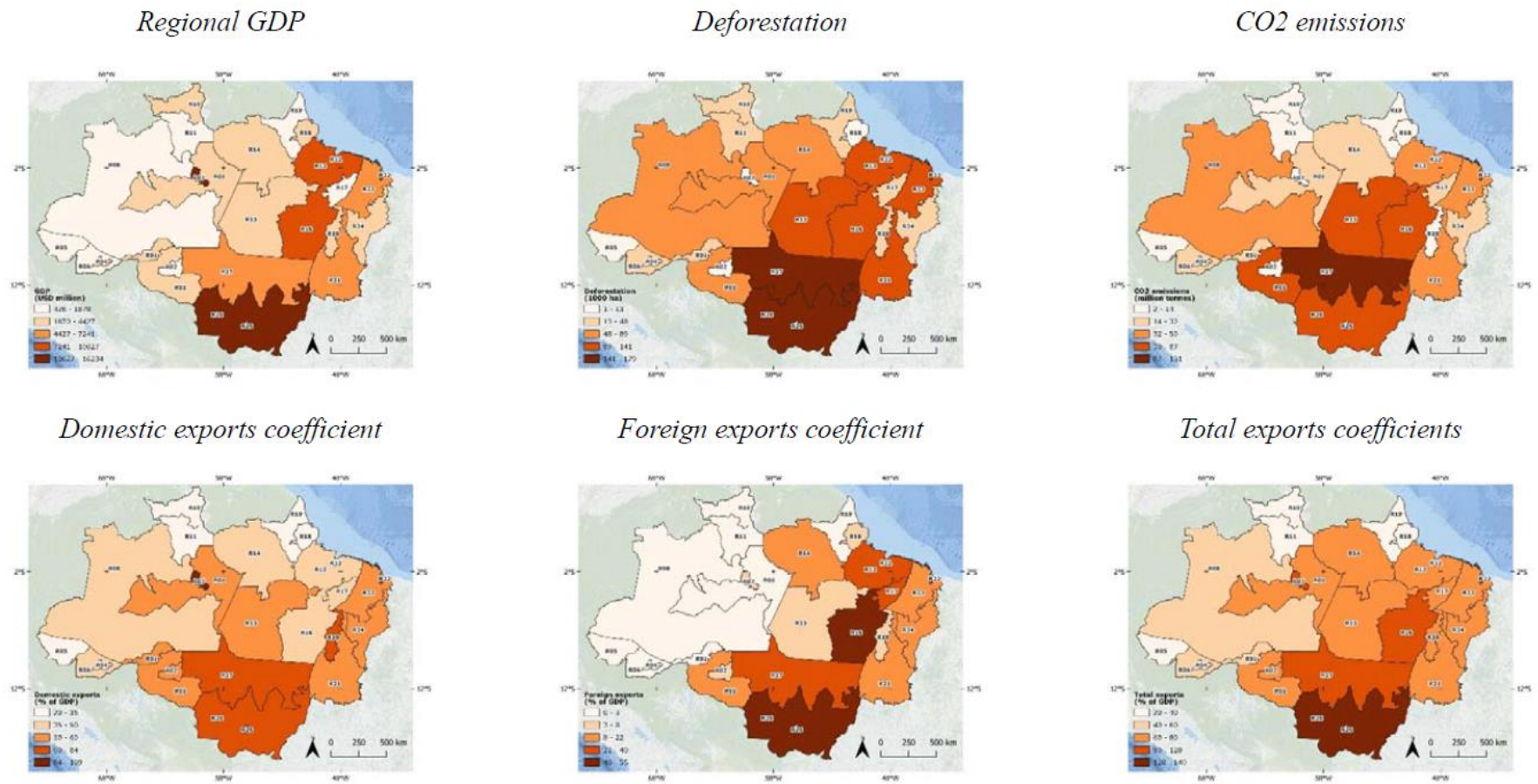|	Exports	Imports	Total
All products			
International trade	17.70	15.22	2.48
Interregional trade	55.12	73.42	-18.30
Agriculture products			
International trade	7.10	0.26	6.84
Interregional trade	9.21	2.83	6.38

Note: The table reports LAM's trade flows as a percentage of regional GDP. The column Total is the sum of Exports and Imports. The data correspond to the year 2015. Source: IIOM-LAM
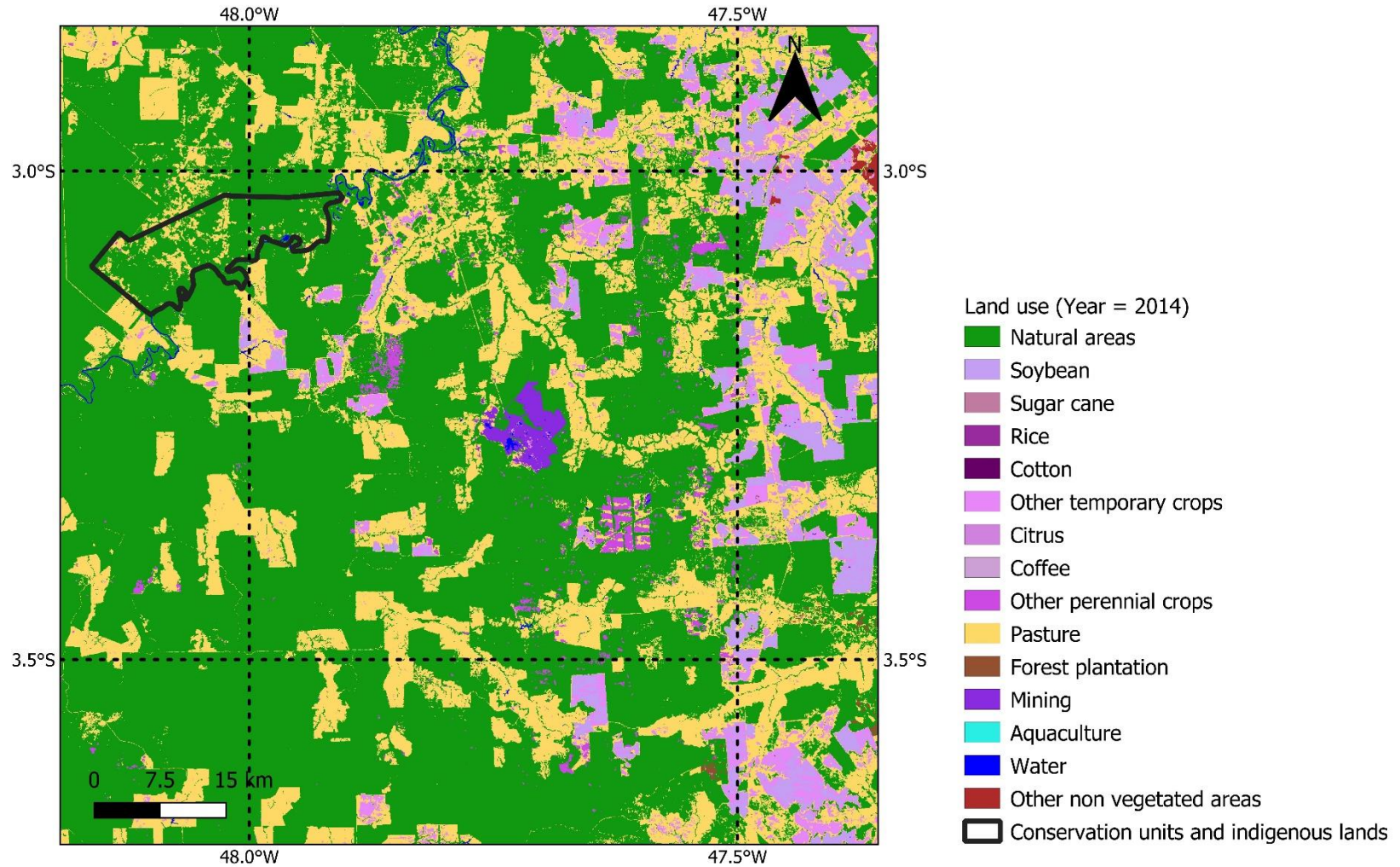
Regional setting

LAM is not homogeneous internally

Figure 1. Regional Indicators for the Brazilian Legal Amazon

Regional GDP   Deforestation   CO2 emissions

Domestic exports coefficient   Foreign exports coefficient   Total exports coefficients
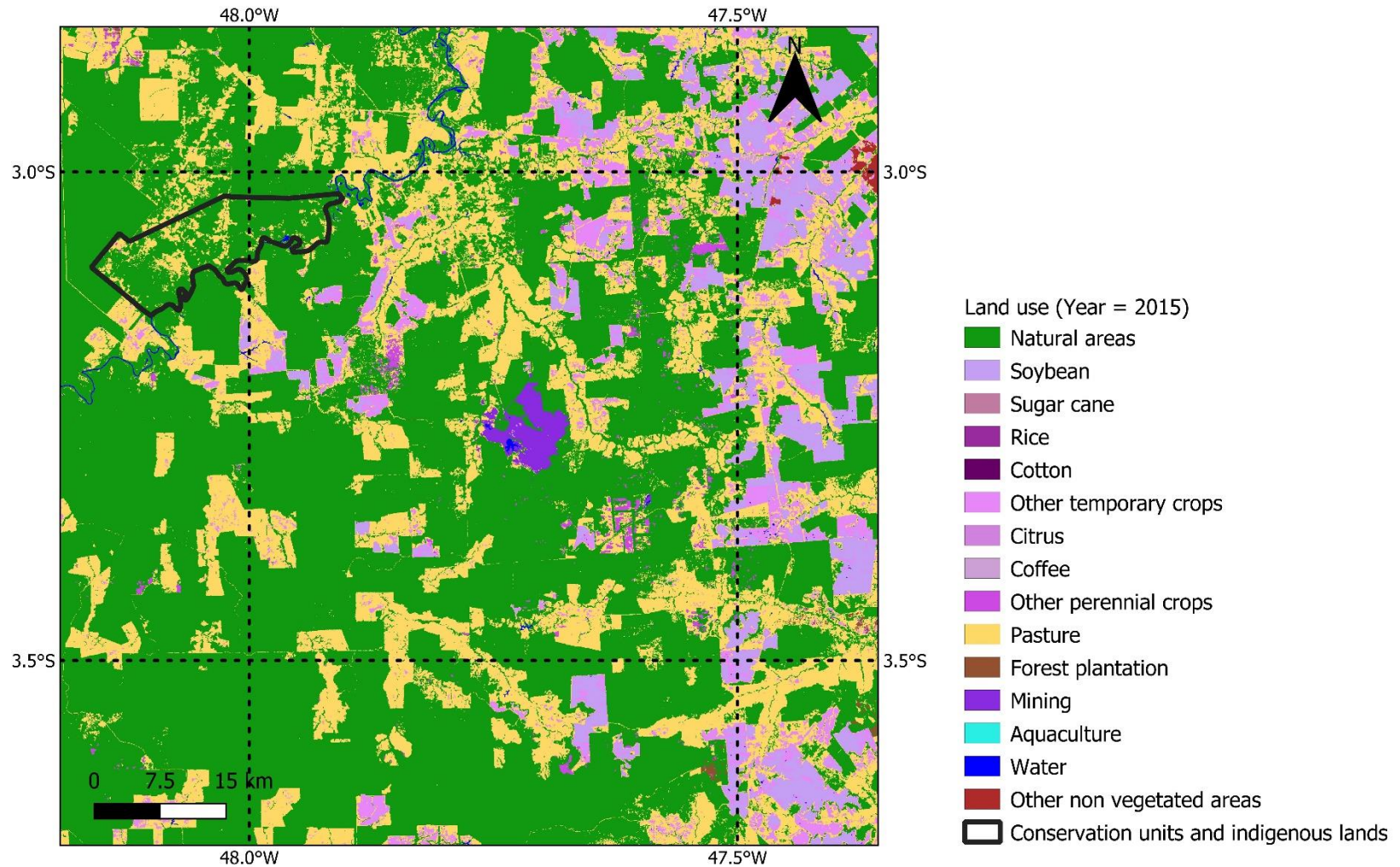
<u>Note</u>: R01 – Aglomerado Porto Velho; R02 – Ji-Paraná; R03 – Ariquemes-Guaporé; R04 – Aglomerado Rio Branco; R05 – Juruá-Tarauacá; R06 – Acre-Purus; R07 – Aglomerado Manaus; R08 – Interior do Amazonas; R09 – Central do Amazonas; R10 – Boa Vista; R11 – Caracaraí; R12 – Aglomerado Belém; R13 – Marajó/Baixo Tocantins; R14 – Baixo Amazonas Paraense; R15 – Sudoeste Paraense; R16 – Sudeste Paraense; R17 – Paragominas; R18 – Macapá; R19 – Oiapoque; R20 – Norte do Tocantins; R21 – Cerrados do Tocantins; R22 – Aglomerado de São Luís; R23 – Oeste do Maranhão; R24 – Chapadas do Maranhão; R25 – Aglomerado de Cuiabá; R26 – Centro Sul do Mato Grosso; R27 – Norte do Mato Grosso. The data correspond to the year 2015.

Changes in land-use (2014)

Land use (Year = 2014)
- Natural areas
- Soybean
- Sugar cane
- Rice
- Cotton
- Other temporary crops
- Citrus
- Coffee
- Other perennial crops
- Pasture
- Forest plantation
- Mining
- Aquaculture
- Water
- Other non vegetated areas
- Conservation units and indigenous lands

Changes in land-use (2015)

Output decomposition

Departing from the conventional input-output model:

$$\mathbf{x} = \begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^R \end{bmatrix} ; \mathbf{A} = \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1R} \\ \vdots & \ddots & \vdots \\ \mathbf{A}^{R1} & \cdots & \mathbf{A}^{RR} \end{bmatrix} ; \mathbf{f} = \begin{bmatrix} \mathbf{f}^1 \\ \vdots \\ \mathbf{f}^R \end{bmatrix} ; \text{ and } \mathbf{B} = \begin{bmatrix} \mathbf{B}^{11} & \cdots & \mathbf{B}^{1R} \\ \vdots & \ddots & \vdots \\ \mathbf{B}^{R1} & \cdots & \mathbf{B}^{RR} \end{bmatrix}$$

$$\mathbf{x}^1 = \mathbf{B}^{11}\mathbf{f}^1 + \cdots + \mathbf{B}^{1R}\mathbf{f}^R$$
$$\vdots$$
$$\mathbf{x}^R = \mathbf{B}^{R1}\mathbf{f}^1 + \cdots + \mathbf{B}^{RR}\mathbf{f}^R$$

Output decomposition

Monetary values of final demand expenditures from the domestic regions in Brazil and the foreign region:

$$\mathbf{V} = \begin{bmatrix} \mathbf{V}^{11} & \cdots & \mathbf{V}^{1R} \\ \vdots & \ddots & \vdots \\ \mathbf{V}^{R1} & \cdots & \mathbf{V}^{RR} \end{bmatrix}; \text{ and } \mathbf{e} = \begin{bmatrix} \mathbf{e}^1 \\ \vdots \\ \mathbf{e}^R \end{bmatrix}$$

$$\mathbf{x}^1 = \mathbf{B}^{11}(\mathbf{V}^{11} + \cdots + \mathbf{V}^{R1} + \mathbf{e}^1) + \cdots + \mathbf{B}^{1R}(\mathbf{V}^{1R} + \cdots + \mathbf{V}^{RR} + \mathbf{e}^R)$$
$$\vdots$$
$$\mathbf{x}^R = \mathbf{B}^{R1}(\mathbf{V}^{11} + \cdots + \mathbf{V}^{R1} + \mathbf{e}^1) + \cdots + \mathbf{B}^{RR}(\mathbf{V}^{1R} + \cdots + \mathbf{V}^{RR} + \mathbf{e}^R)$$

Regional output depends on demand originating in the region and also on demand from outside the region

VA & deforestation decomposition by source of FD

Table 2. Components of Decomposition of Regional GDP and Deforestation Based on the Sources of Final Demand

GDP (2015 USD billion)

	REGIONAL ORIGIN OF FINAL DEMAND			TOTAL
	LAM	RBR	FOR	
LAM	73.12	43.15	18.18	134.45
RBR	63.50	1196.94	155.83	1416.26
TOTAL	136.62	1240.09	174.01	1550.72

Deforestation (1000 ha)

	REGIONAL ORIGIN OF FINAL DEMAND			TOTAL
	LAM	RBR	FOR	
LAM	259.21	919.41	361.84	1540.46
RBR	41.47	580.14	185.50	807.11
TOTAL	300.68	1499.55	547.34	2347.57

(%)

	REGIONAL ORIGIN OF FINAL DEMAND			TOTAL
	LAM	RBR	FOR	
LAM	53.52	3.48	10.45	8.67
RBR	46.48	96.52	89.55	91.33
TOTAL	100.00	100.00	100.00	100.00

(%)

	REGIONAL ORIGIN OF FINAL DEMAND			TOTAL
	LAM	RBR	FOR	
LAM	86.21	61.31	66.11	65.62
RBR	13.79	38.69	33.89	34.38
TOTAL	100.00	100.00	100.00	100.00

(%)

	REGIONAL ORIGIN OF FINAL DEMAND			TOTAL
	LAM	RBR	FOR	
LAM	54.38	32.09	13.52	100.00
RBR	4.48	84.51	11.00	100.00
TOTAL	8.81	79.97	11.22	100.00

(%)

	REGIONAL ORIGIN OF FINAL DEMAND			TOTAL
	LAM	RBR	FOR	
LAM	16.83	59.68	23.49	100.00
RBR	5.14	71.88	22.98	100.00
TOTAL	12.81	63.88	23.32	100.00

Note: LAM = Brazilian Legal Amazon; RBR = Rest of Brazil; FOR = Foreign markets. The table reports, in the first row, the decomposition of LAM's GDP and deforestation driven by local (LAM) and external (RBR and FOR) demand. Analogous results are presented for RBR, in the second row. Results are presented in levels and percentage shares. The data correspond to the year 2015. Source: Authors' calculations using the IIOM-LAM

Measurement of regional value-added in interregional and international trade flows

The national interregional input-output model can be expressed as

$$\begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^n \end{bmatrix} = \begin{bmatrix} \mathbf{A}^{11} & \cdots & \mathbf{A}^{1n} \\ \vdots & \ddots & \vdots \\ \mathbf{A}^{n1} & \cdots & \mathbf{A}^{nn} \end{bmatrix} \begin{bmatrix} \mathbf{x}^1 \\ \vdots \\ \mathbf{x}^n \end{bmatrix} + \begin{bmatrix} \mathbf{f}^{11} & \cdots & \mathbf{f}^{1n} & \mathbf{f}^{1row} \\ \vdots & \ddots & \vdots & \vdots \\ \mathbf{f}^{n1} & \cdots & \mathbf{f}^{nn} & \mathbf{f}^{nrow} \end{bmatrix} \mathbf{i}$$

Following Los et al. (2016), the value-added in region 1 (VA_1) can be expressed as

$$VA_1 = \mathbf{v}_1 (\mathbf{I} - \mathbf{A})^{-1} \mathbf{f} \mathbf{i}$$

where $\mathbf{v}_1$ is a row vector with ratios of value-added to gross output in industries in region 1 as first elements ($\tilde{\mathbf{v}}_1$) and zeros elsewhere ($\mathbf{v}_1 = [\tilde{\mathbf{v}}_1 \ \ 0]$); $\mathbf{A}$ is a technical coefficient matrix; $\mathbf{I}$ is an identify matrix; $\mathbf{f}$ is a final demand matrix; $\mathbf{i}$ is a summation vector

Measurement of regional value-added in interregional and international trade flows (cont.)

In order to attribute the amount of domestic/regional value-added in exports from region 1 to region n, we consider a hypothetical world where region 1 does not export anything to region n. In this case, the new *VA* or hypothetical *VA* can be represented by

$$VA^*_{1,n} = \mathbf{v}_1(\mathbf{I} - \mathbf{A}^*_{1,n})^{-1}\mathbf{f}^*_{1,n}\mathbf{i}$$

In addition, in order to attribute the amount of domestic/regional value-added in exports from region 1 to the RoW, we consider a hypothetical world where region 1 does not export to the RoW. In this case, the hypothetical VA can be represented as:

$$VA^*_{1,row} = \mathbf{v}_1(\mathbf{I} - \mathbf{A})^{-1}\mathbf{f}^*_{1,row}\mathbf{i}$$

Measurement of regional value-added in interregional and international trade flows (cont.)

We can define the domestic value-added in exports (*DVA*) from region 1 to region *n* as follows:

$$DVA_{1,n} = VA_1 - VA^*_{1,n}$$

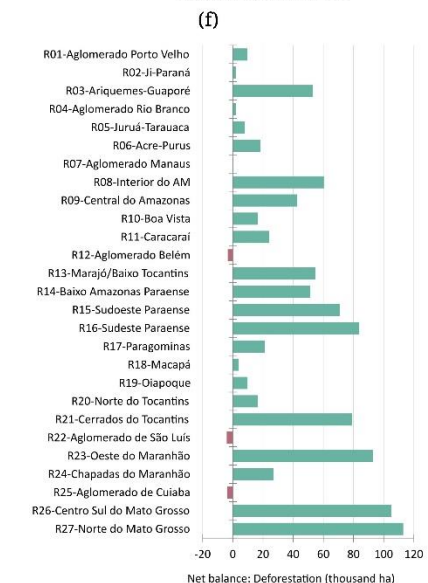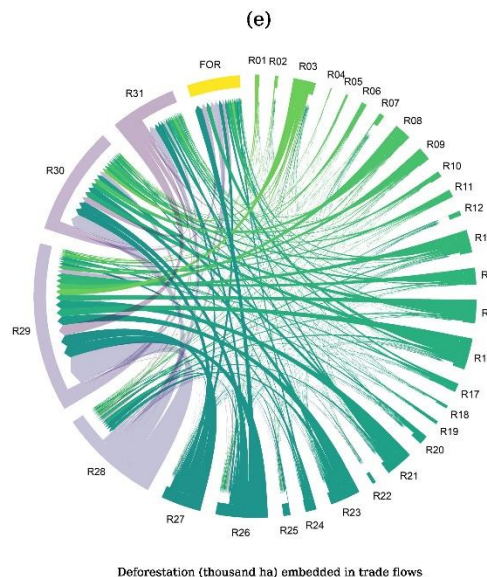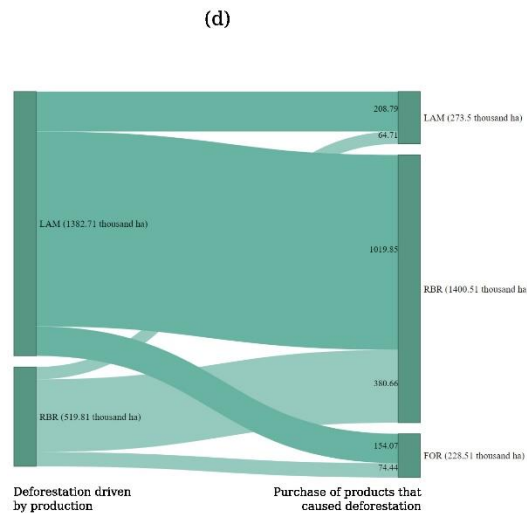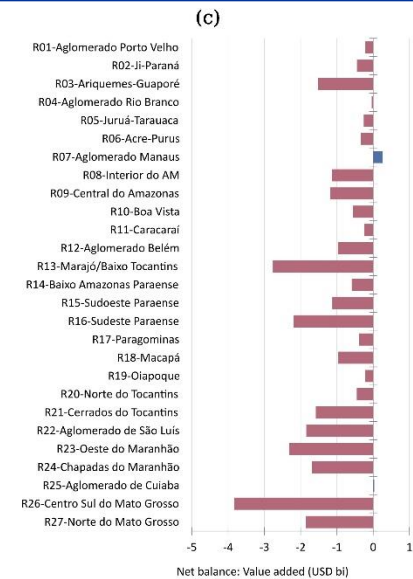We can define DVA in exports from region 1 to the RoW as

$$DVA_{1,row} = VA_1 - VA^*_{1,row}$$

Domestic/regional value-added in trade flows (DVA)

Hypothetical no export	to					
from	R_1	R_2	...	R_{n-1}	R_n	RoW
R_1		$DVA_{1,2}$	...	$DVA_{1,n-1}$	$DVA_{1,n}$	$DVA_{1,row}$
R_2	$DVA_{2,1}$		...	$DVA_{2,n-1}$	$DVA_{2,n}$	$DVA_{2,row}$
⋮	⋮	⋮	⋮	⋮	⋮	⋮
R_{n-1}	$DVA_{n-1,1}$	$DVA_{n-1,2}$	...		$DVA_{n-1,n}$	$DVA_{n-1,row}$
R_n	$DVA_{n,1}$	$DVA_{n,2}$	...	$DVA_{n,n-1}$		$DVA_{n,row}$

Total value added content in exports from R1 to R2

Regional traded value-added and deforestation in exports, by origin of demand

(a)

(b)

Value added (US$ Bi) embedded in trade flows

(c)

Net balance: Value added (USD bi)

(d)

(e)

Deforestation (thousand ha) embedded in trade flows

(f)

Net balance: Deforestation (thousand ha)
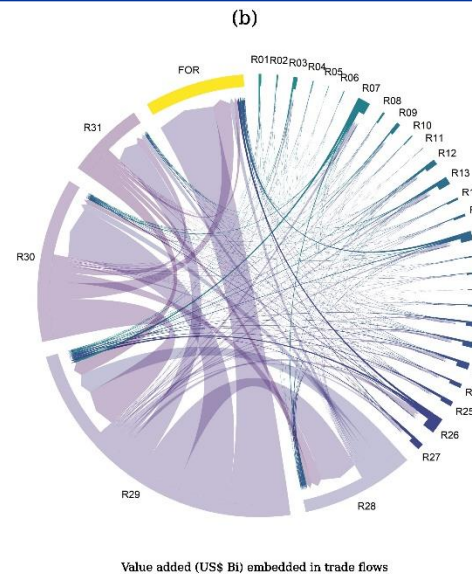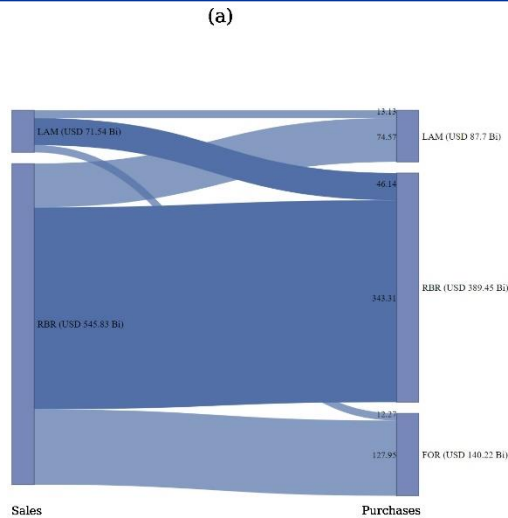
Final remarks

Our results demonstrate how the emphasis on international trade in the current literature on economic drivers of land-use change neglected internal sources of interactions.

Acknowledging domestic markets as a critical driver of changes in forest cover in the region switches the focus of the debate emphasizing the need for increased engagement by national stakeholders to be part of concerted efforts to find solutions to the problem.

Attribution of co-responsibility to specific regions must be considered to inform policymakers about potential future stress in Amazon's resources.
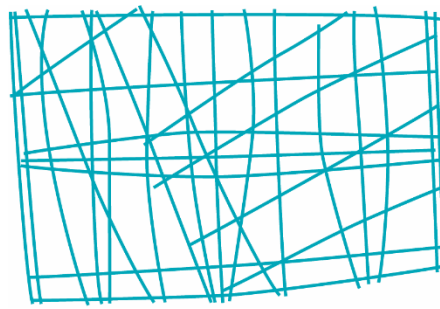
Thank you!

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Eduardo A. Haddad

Professor of Economics, University of São Paulo, Brazil