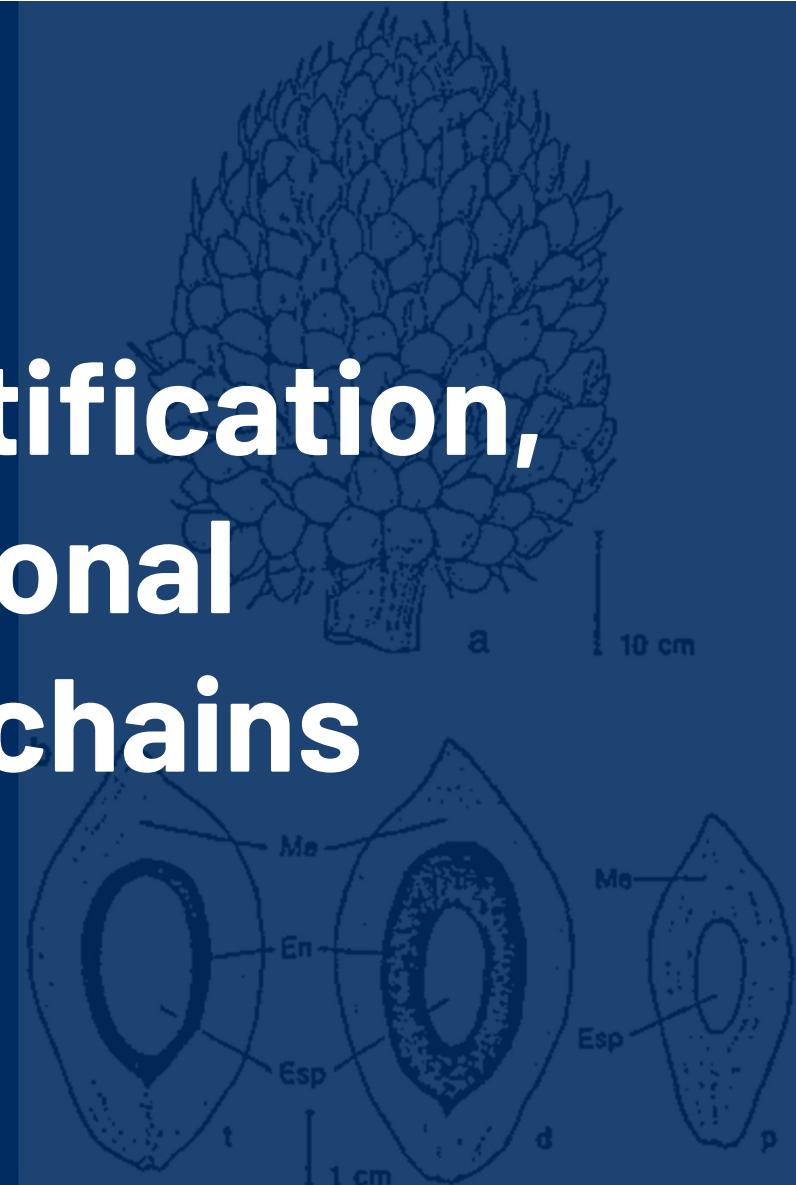


Deforestation, certification, and transnational palm oil supply chains



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Research article
 Deforestation, certification, and transnational palm oil supply chains:
 Linking Guatemala to global consumer markets

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ABSTRACT

Although causal links between tropical deforestation and palm oil are well established, linking this land use change to where the palm oil is actually consumed remains a distinct challenge and research gap. Supply chains are notoriously difficult to track back to their origin (i.e., the ‘first-mile’). This poses a conundrum for corporations and governments alike to continue to encourage consumers to purchase sustainably produced oil through certification to increase supply chain transparency and sustainability. The Roundtable on Sustainable Palm Oil (RSPO) offers the most influential certification system in the sector, but whether it actually reduces deforestation is still unclear. This study used remote sensing and spatial analysis to assess the deforestation (2009–2019) caused by oil palm plantation expansion in Guatemala, a major palm oil source for international consumer markets. Our results reveal that plantations are responsible for 28% of deforestation in the region and that more than 60% of these plantations encroach on Key Biodiversity Areas. RSPO-certified plantations, comprising 63% of the total cultivated area assessed, did not produce a statistically significant reduction in deforestation. Using trade statistics, the study linked this deforestation to the palm oil supply chains of three transnational corporations: Wilmar International, Bunge, and Cargill-CorCoppelia. Addressing the deforestation and supply chain sustainability challenge hinges on three measures: 1) reform of RSPO policies and practices; 2) robust corporate tracking of supply chains; and 3) strengthening forest governance in Guatemala. This study offers a replicable methodology for a wide-range of investigations that seek to understand the transnational linkages between environmental change (e.g. deforestation) and consumption.

1. Introduction

Tropical deforestation – which is primarily driven by commodity production – has major, potentially irreversible, global implications for biodiversity (Bentley et al., 2021), ecosystem functioning (IPBES, 2019), soil health (Foley et al., 2005), hydrological cycles (Bala et al., 2007), carbon emissions (Smith et al., 2014), and livelihoods (Newton and Benzecri, 2018). Beef, palm oil, soy, and wood products alone account for 40% of tropical deforestation globally (Henders et al., 2015).

Palm oil is particularly pernicious given its new utility, cheap, versatile, and growing demand in the modern food supply chain, and is found in roughly half of all packaged supermarket products – from bread and butter, to shampoo and toothpaste (GVWT, 2022a). Since 2000, palm oil production has more than tripled (Cores, 2022) and an additional 36 million hectares (ha) of land will be required by 2050 to meet projected demand (Meijaard et al., 2020).

Scholarship on the connection between palm oil and deforestation has primarily focused on Southeast Asia, especially Indonesia and Malaysia, where most production occurs (Penndrill et al., 2019). But the region’s producers face shrinking land availability and increasing scrutiny, driving expansion in new production geographies. With the largest global forest reserves suitable for oil palm production, Latin America has emerged as the next frontier and is already the second largest producing region (Castellanos-Navarrete et al., 2021; Puniamo and Aide, 2017). In the last just over decade (2010–2020), palm oil production in Latin America has reportedly doubled (FAO, 2017, 2020).

Palm oil expansion has been spearheaded in Guatemala, which boasts the highest productivity per ha globally (Tropical Forest Alliance, 2019). By 2030, Guatemala is projected to become the world’s third largest palm oil producer, after Indonesia and Malaysia (Tropical Forest

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Presentation Outline

1. Introduction

- 1. Background
- 2. Methods
- 3. Results
- 4. Conclusions

Image from [SEI](#)



Image from [Betterfood UK](#)

2. Background

The driving research question:

To what extent is (RSPO-certified) palm oil production and trade associated with measurable impacts on land-use patterns (i.e., the alteration of forest landscapes) over time (2009-2019)?

2. Background

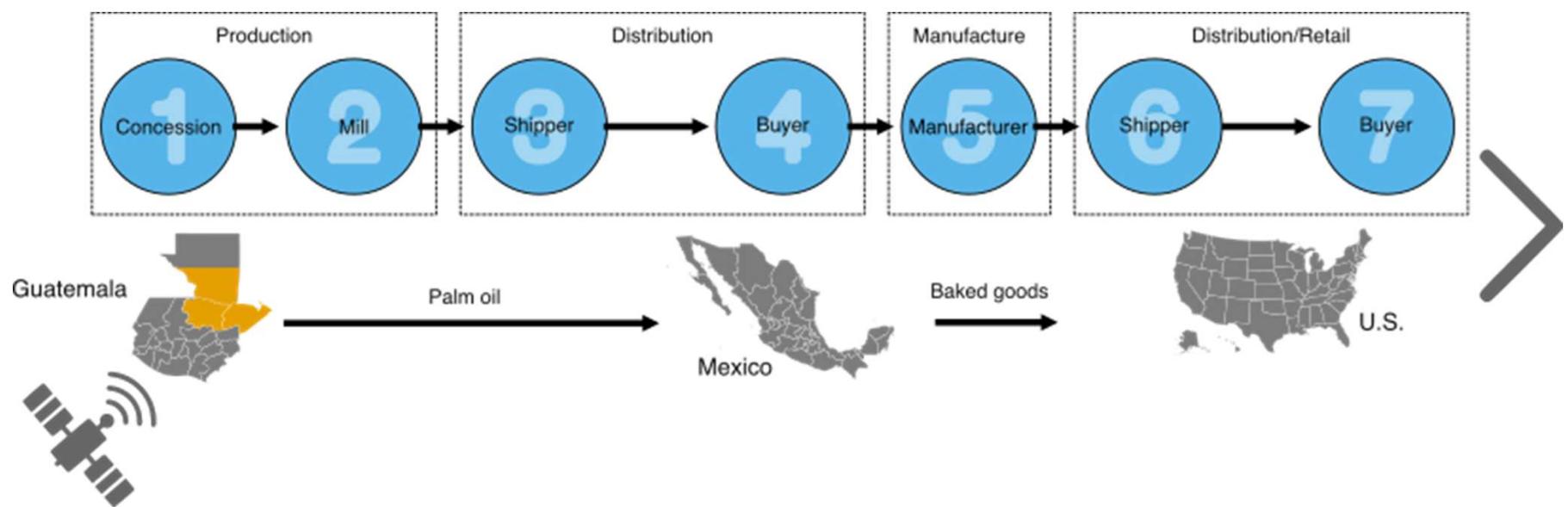
Guatemala: Palm oil's latest frontier

- Historically produced in Southeast Asia
- Highest productivity per ha globally
- Projected to become the world's third largest palm oil producer, after Indonesia and Malaysia, by 2030¹

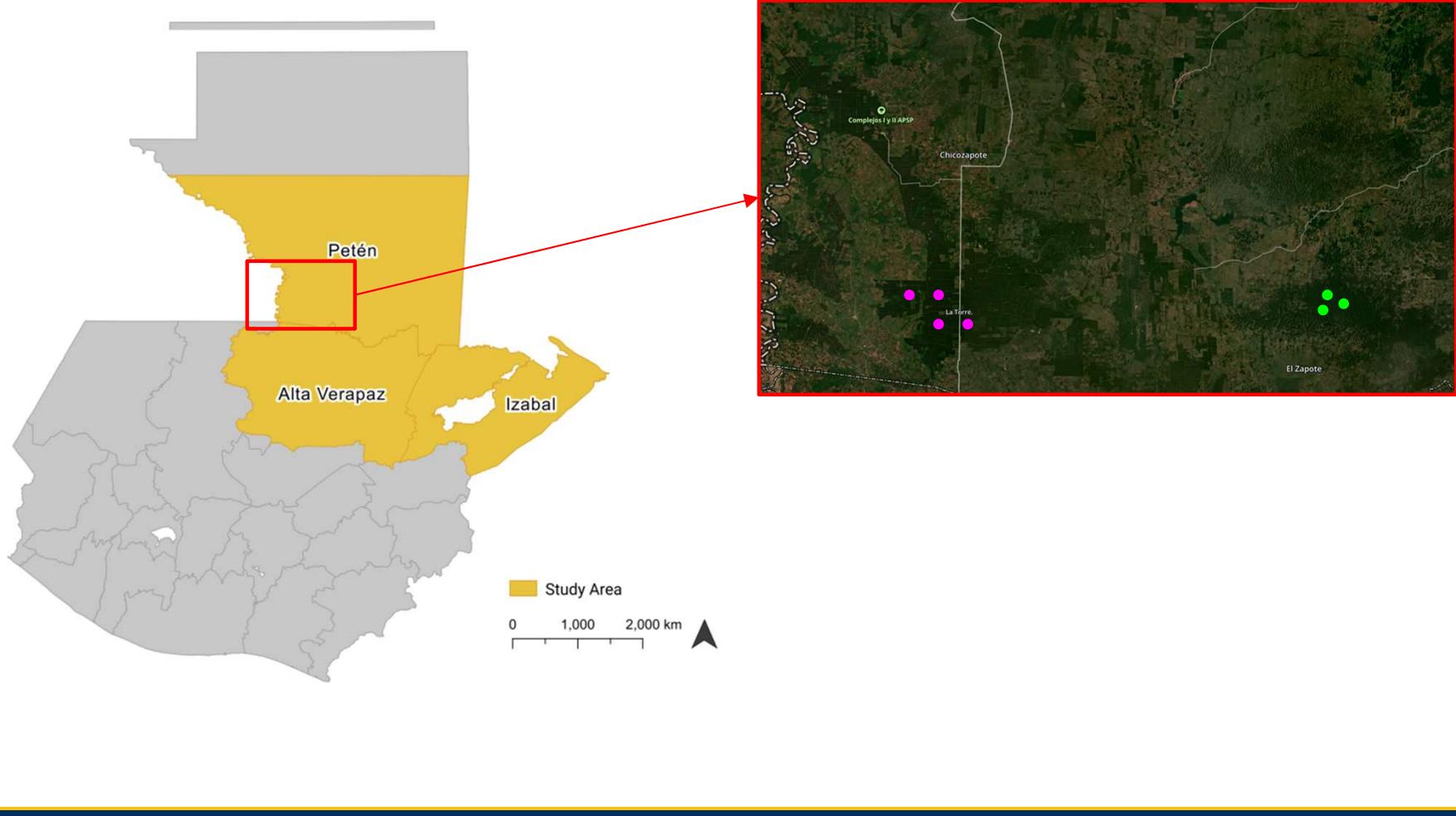


1. Tropical Forest Alliance. (2019). A “commodity-first” approach to identifying landscapes for private sector engagement.

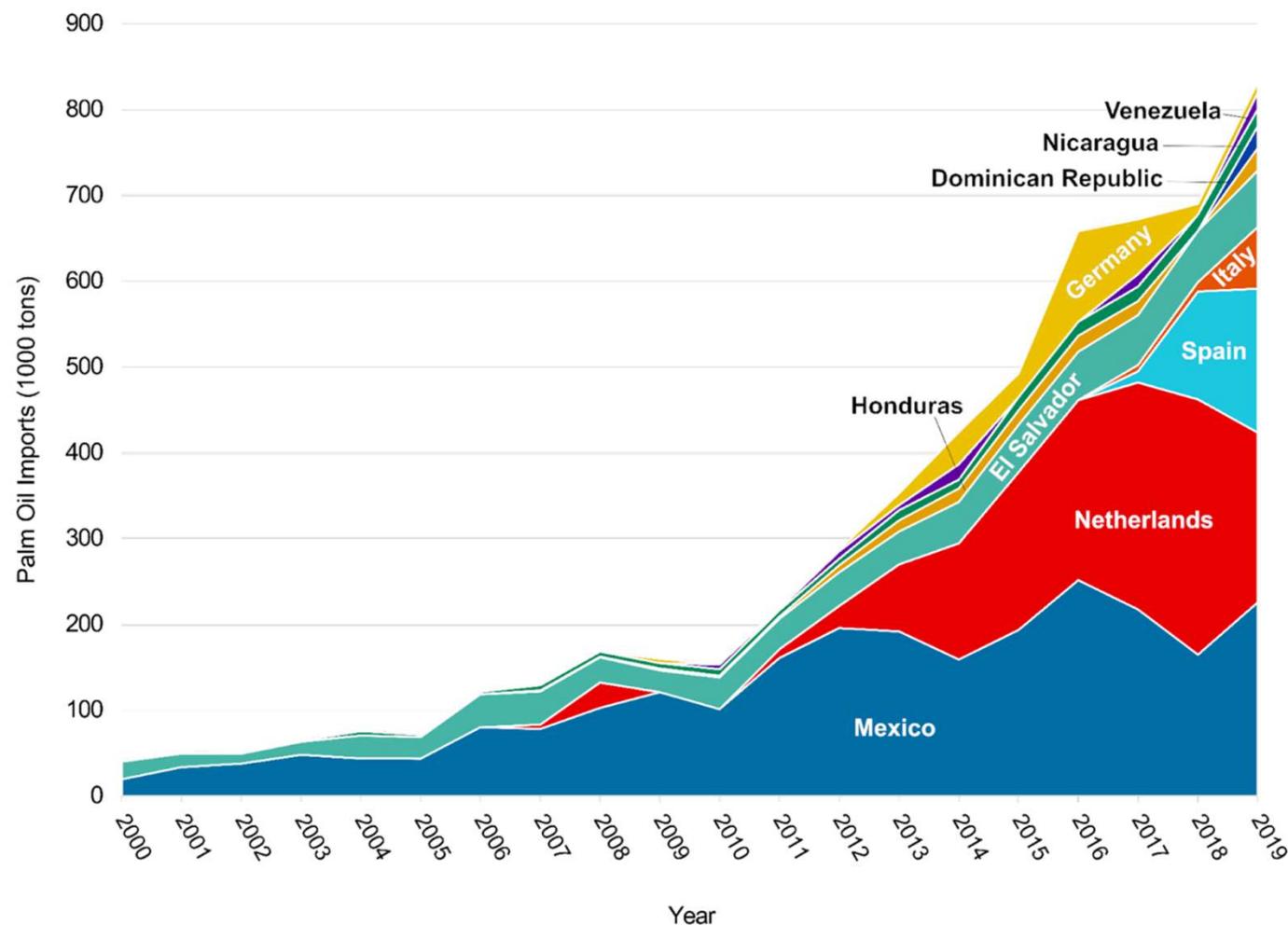
2. Background



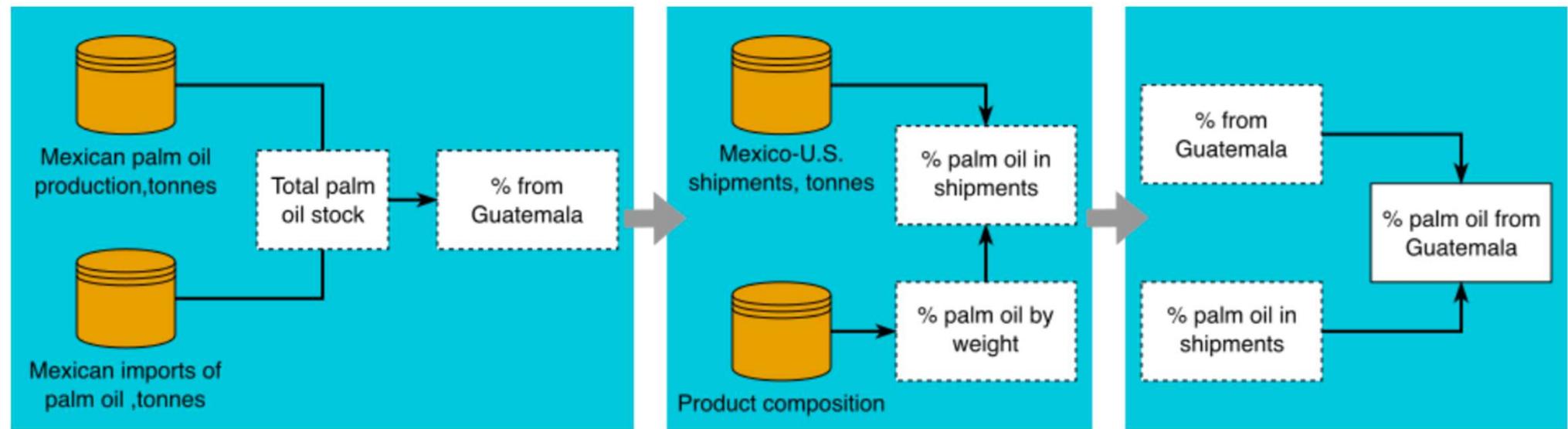
3. Methods



3. Methods



3. Methods



3. Methods

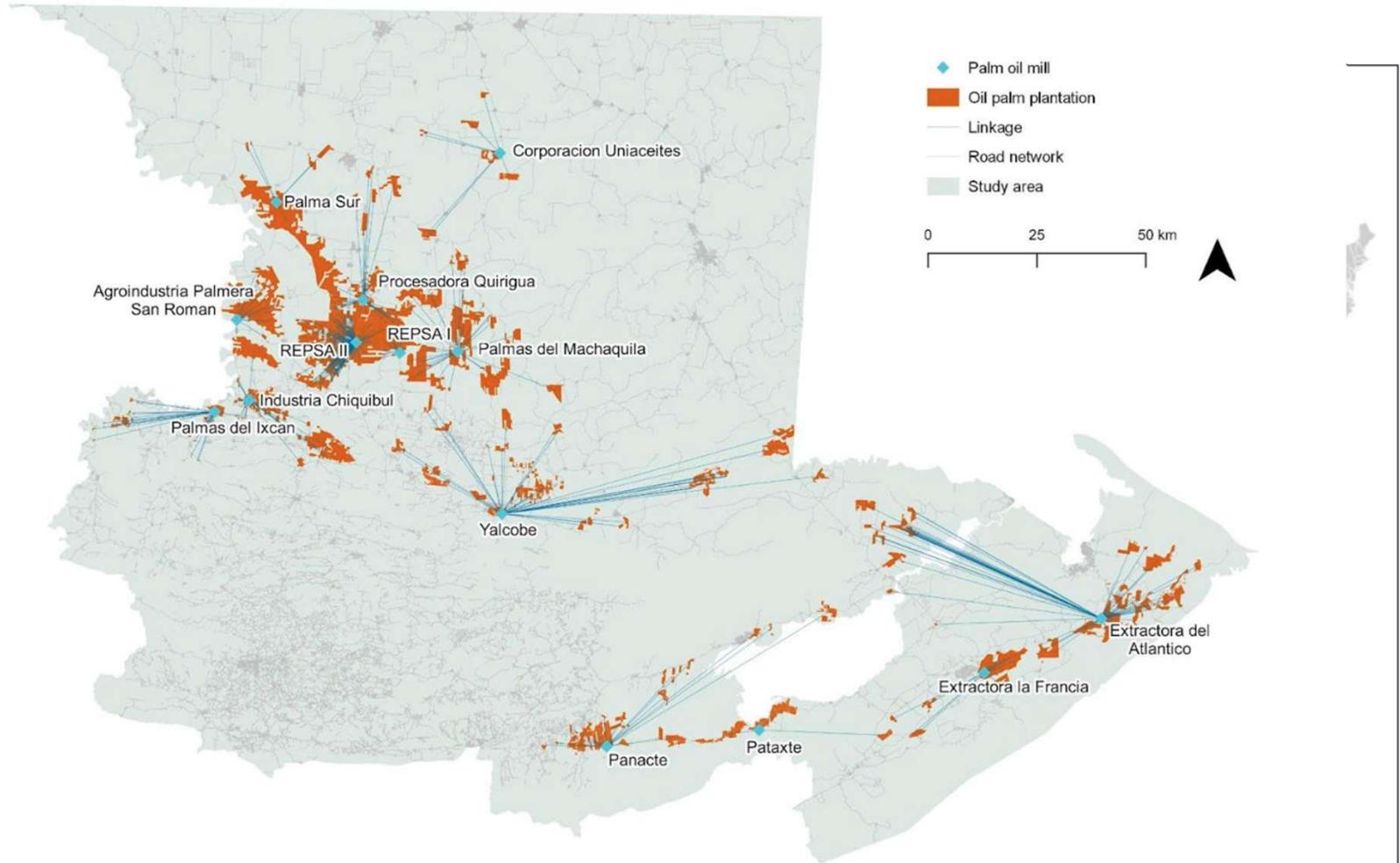
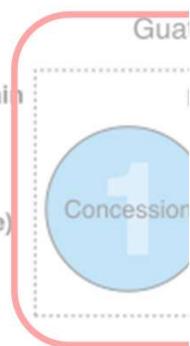
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Geography

Supply Chain
Process

Corporate
Actor (node)

Good



3. Methods

PepsiCo Palm Oil Mill List 2021

The following palm oil mill list is based on information that has been self-reported to us by suppliers for the calendar year 2021. While we have made considerable effort to validate the data including through independent verification (see our Palm Oil Disclosure for more information) we cannot guarantee its full accuracy or completeness.

Some of these mills are associated with ongoing complaints that have been registered in our Grievance Mechanism and are being managed through our grievance process and / or may no longer be in our supply chain.

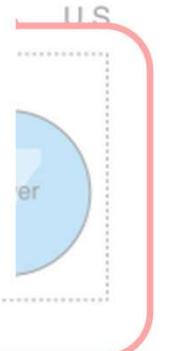
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Geography



Supply Chain Process

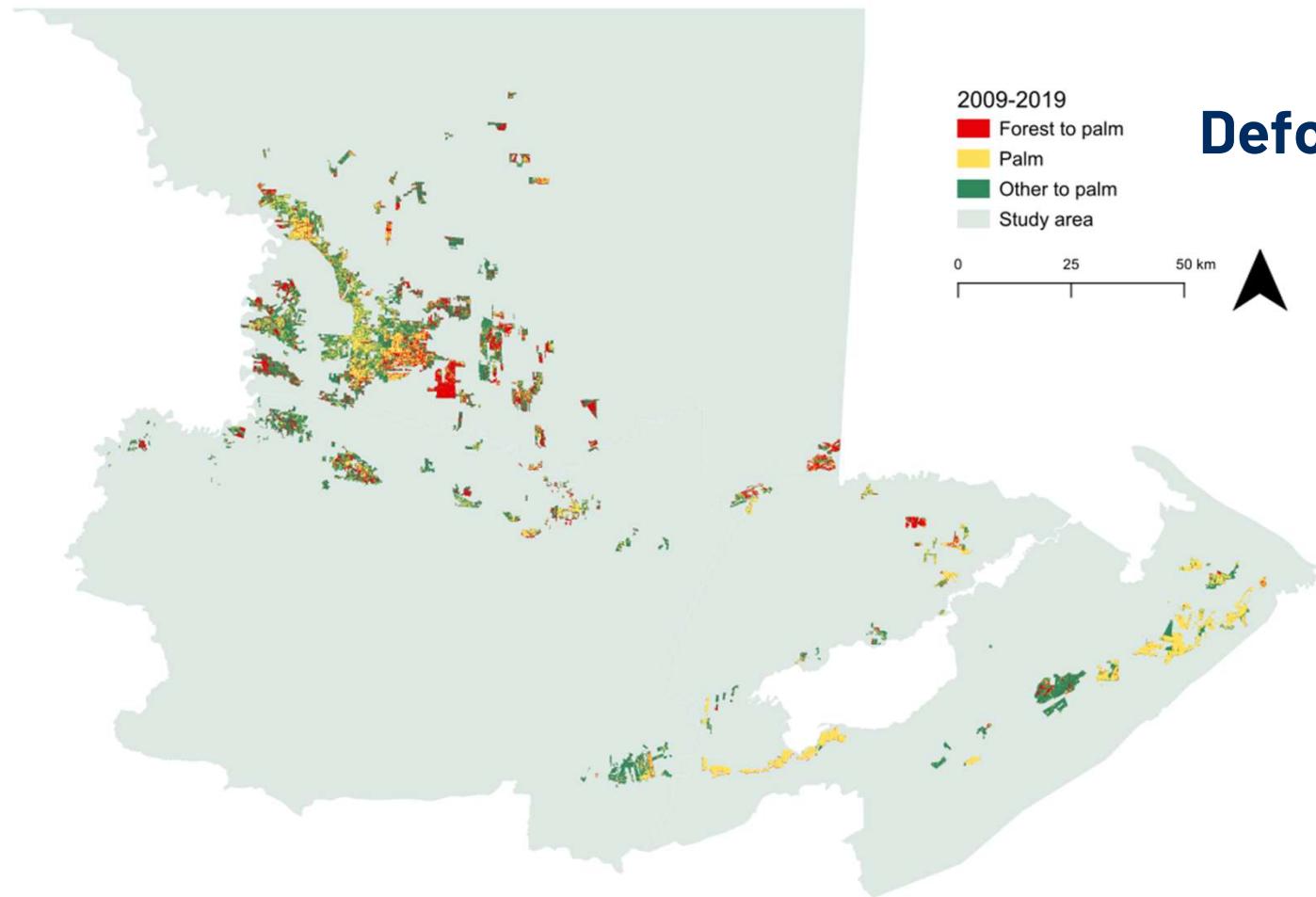
Corporate Actor (node)



3. Methods

Key Findings

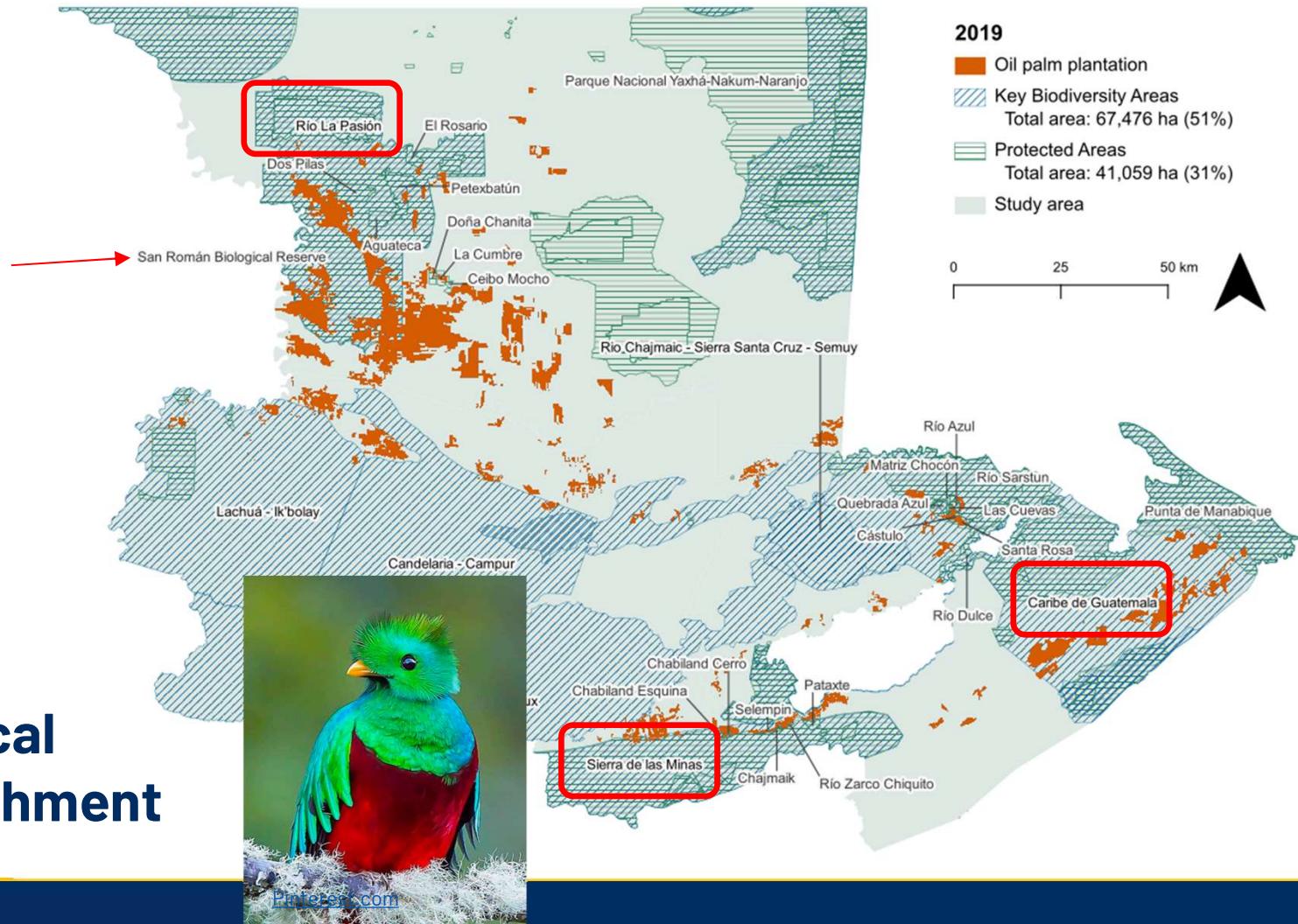
- Linked transnational supply chains that end in the US to deforestation and ecological encroachment in Guatemala
 - Pepsico, Mondelēz, and Grupo Bimbo incur deforestation risks in their palm oil supply chains
- Oil palm plantations expanded **87,325 ha** between 2009 and 2019
 - **28% replaced forestland**
- RSPO-certification did not effectively protect against deforestation or ecological encroachment



Deforestation

4. Results

Ecological encroachment



Pintedext.com

4. Results

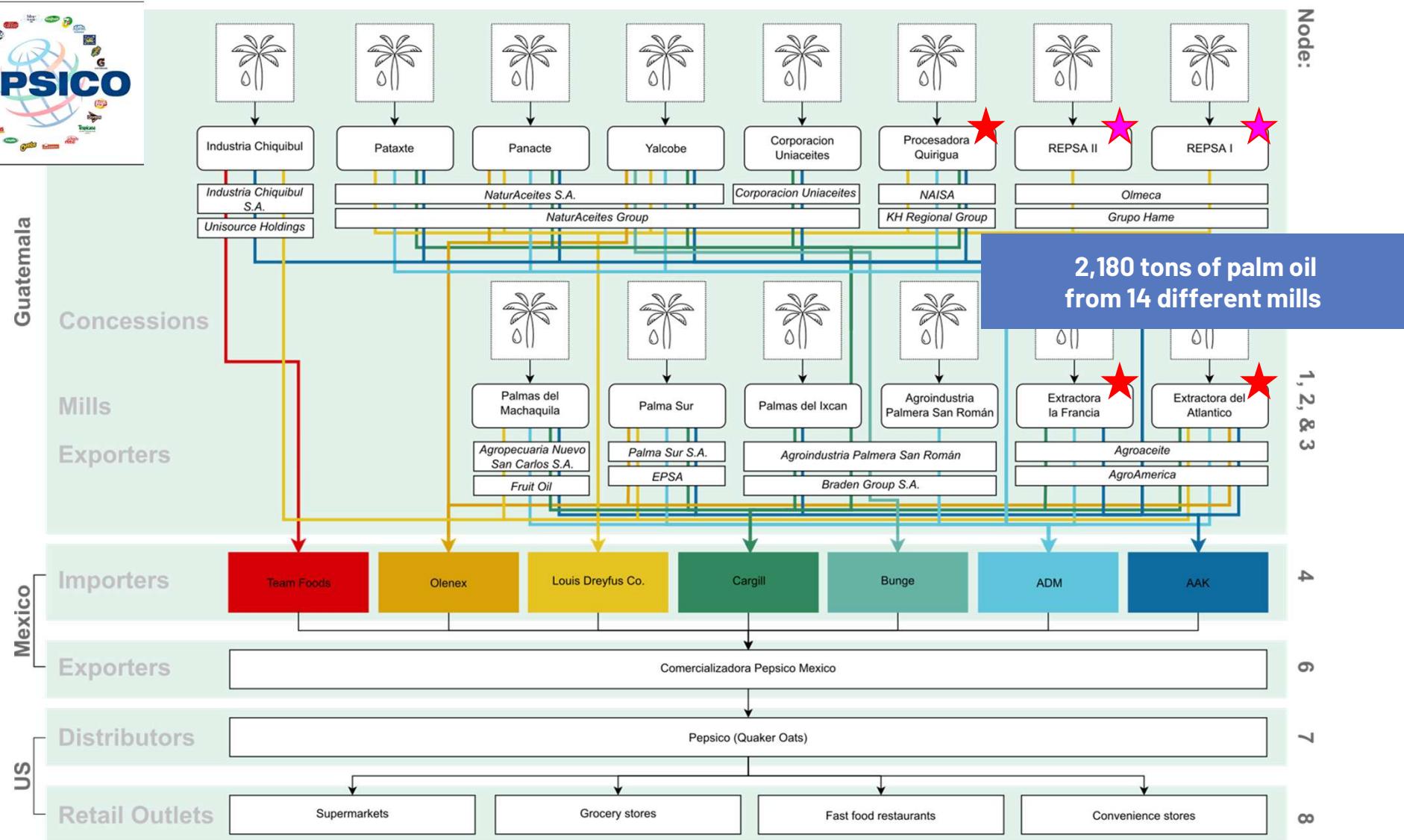
Results of the spatial Lag models used to determine whether RSPO-certification is associated with heightened deforestation and ecological encroachment (** = $p < 0.001$; ** = $p < 0.01$; * = $p < 0.05$).

Deforestation model	Estimate	Standard error	z-value	P-value	VIF	95% CI
(Intercept)	51.77	320.25	-0.16	0.87		-679.45–575.90
RSPO-certification	-6.56	13.16	-0.50	0.62	2.02	-32.34–19.23
Total plantation area (ha)	0.16***	0.01	13.05	< 2.2e-16	1.42	0.14–0.19
Ecological encroachment (ha)	0.04	0.02	1.65	0.10	1.74	-0.01–0.08
Average annual precipitation, mm	0.05***	0.01	4.03	0.00	3.38	0.03–0.08
Average annual temperature, °C	-3.96	11.64	-0.34	0.73	1.73	-26.78–18.86
Distance to palm oil mill	0.00	0.00	-1.09	0.28	1.24	-0.01–0.00
Distance to pastureland	-0.02*	0.01	-1.95	0.05	1.70	-0.03–0.00
Distance to road	0.03	0.02	1.32	0.19	1.43	-0.02–0.08
Population density, # of people per pixel	-0.05	0.07	-0.65	0.52	1.38	-0.19–0.09
Slope	9.84	7.08	1.39	0.16	1.28	-4.03–23.71
Ecological encroachment model	Estimate	Standard error	z-value	P-value	VIF	95% CI
(Intercept)	3750.87**	1004.64	3.74	0.00		1787.80–5725.93
RSPO-certification	-38.05	39.75	-0.96	0.34	2.01	-115.96–39.85
Total plantation area (ha)	0.20***	0.05	4.00	0.00	2.48	0.10–0.29
Deforestation (ha)	0.29	0.21	1.38	0.17	2.46	-0.12–0.71
Average annual precipitation, mm	-119.10***	36.06	-3.30	0.00	1.62	-189.78–48.42
Average annual temperature, °C	-0.18***	0.04	-4.04	0.00	3.35	-0.26–0.09
Distance to palm oil mill	-0.01	0.01	-1.15	0.25	1.24	-0.02–0.01
Distance to pastureland	0.01	0.02	0.49	0.63	1.77	-0.03–0.06
Distance to road	0.10	0.07	1.41	0.16	1.43	-0.04–0.25
Population density, # of people per pixel	0.25	0.21	1.19	0.23	1.37	-0.16–0.67
Slope	-1.81	21.46	-0.08	0.93	1.29	-43.87–40.24

4. Results

Company linkages to these changes

4. Results

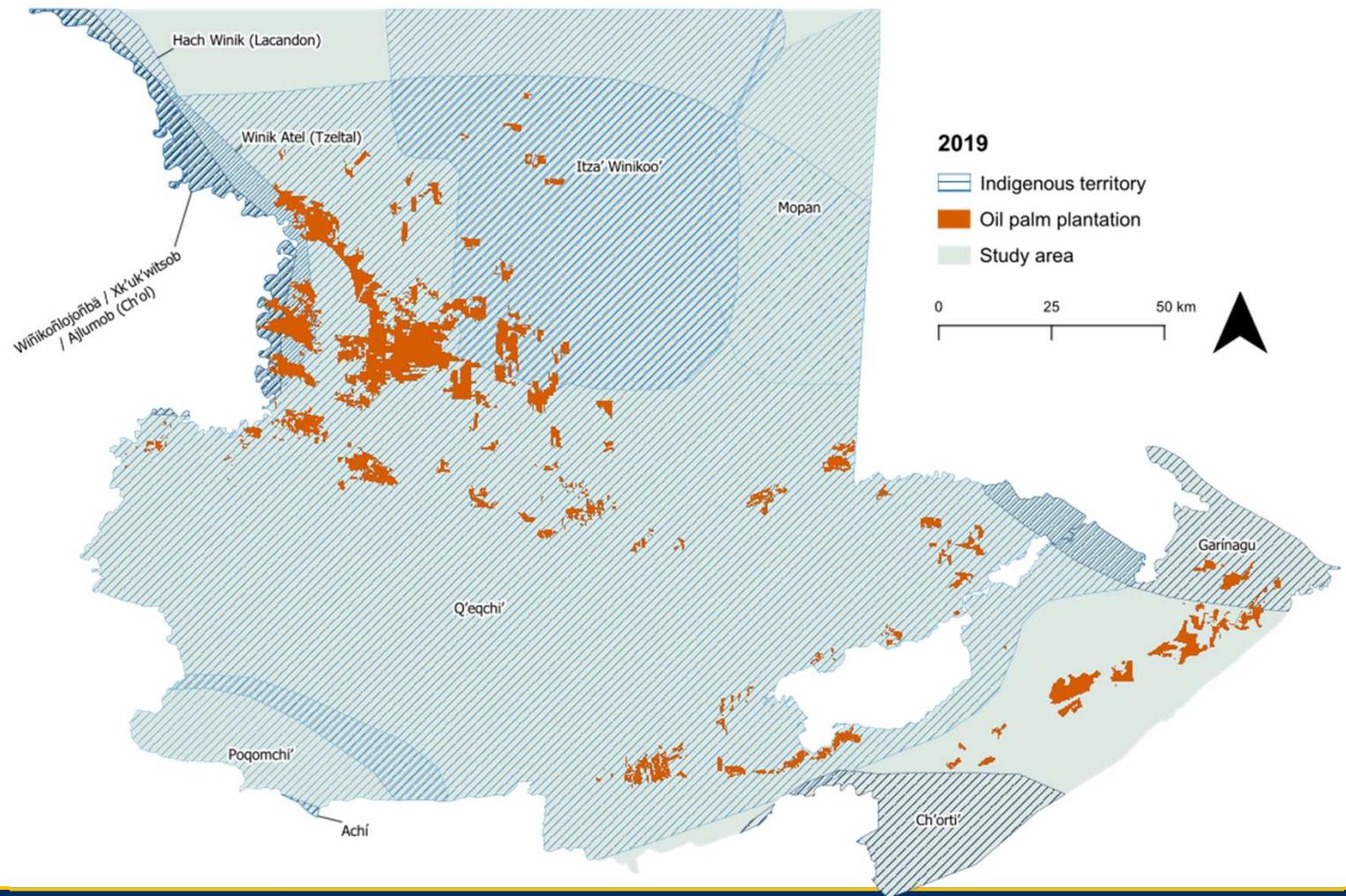


Deforestation teleconnections

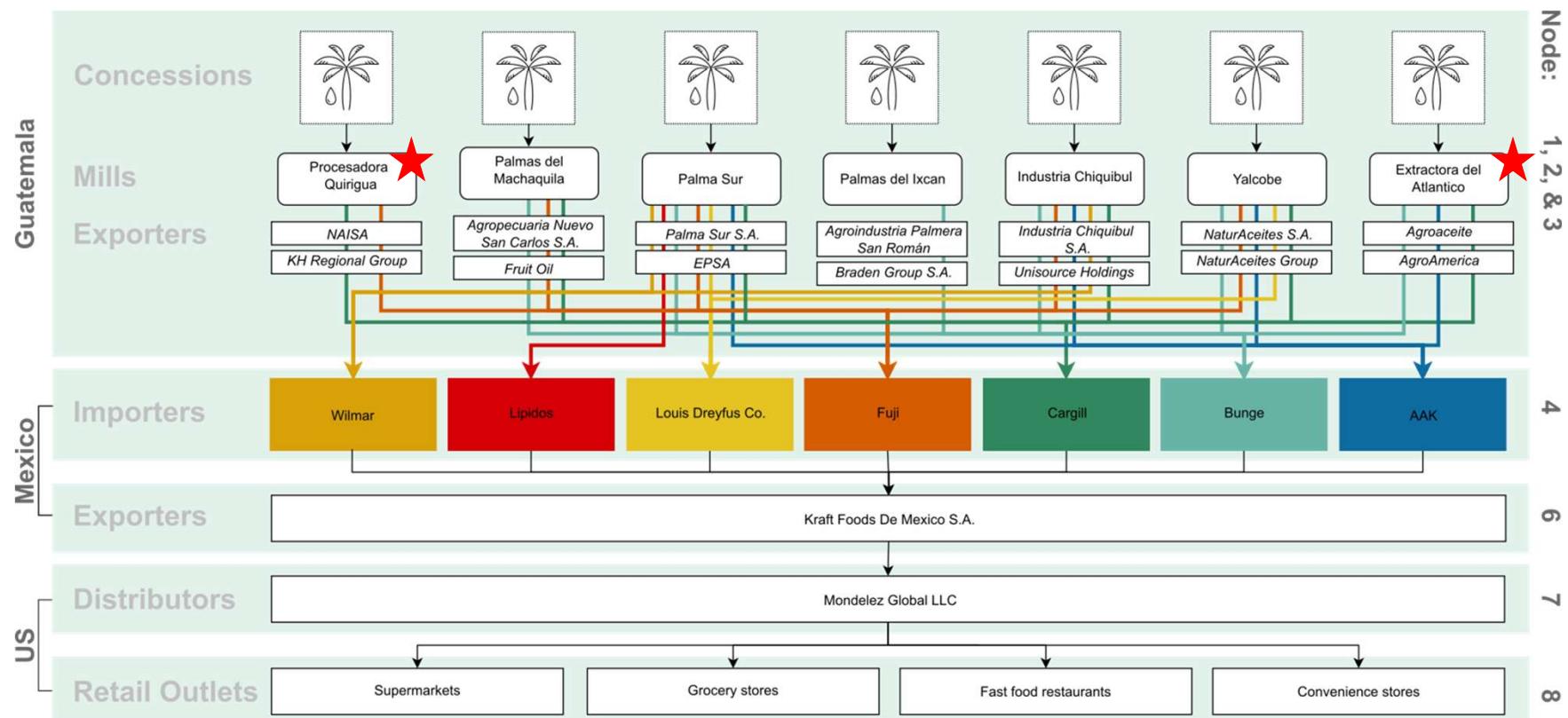
- More than 99% of the deforestation observed can be connected to the plantations supplying palm oil to PepsiCo's and Grupo Bimbo's palm oil mills and 72% to the subset of plantations supplying Mondelēz's palm oil mills.
- RSPO-certified mills collectively expanded on 3,584 ha of forestland

Conclusions

- Length and complexity of palm oil supply chains makes it difficult to establish causal links between land use change and consumption-based drivers
- Early traceability challenges (plantation-mill linkages) hinder our ability to identify supply chain origins and establish deforestation-free sourcing
- RSPO-certification does not effectively mitigate deforestation risks



5. Conclusions



600 tons of palm oil
from 7 different mills

