

Chips, Dip, and a Side of Deforestation? U.S. Agricultural Trade and Deforestation Policy Beyond Avocados

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U.S. lawmakers have raised concerns about Mexican avocado imports and their environmental impacts, particularly deforestation. We analyze recent patterns in deforestation in Mexico and discuss the scope and potential challenges of proposals to reduce forest loss. Examining policies in the United States and Europe, we explore both supply- and demand-side approaches to agricultural trade and deforestation more broadly, as well as the potential effects of those policies on U.S. and Californian producers and consumers.

On February 7, 2024, a group of U.S. senators addressed a letter to Secretary of State Antony Blinken, U.S. Trade Representative Katherine Tai, and Secretary of Agriculture Thomas Vilsack, expressing their concerns about the environmental and social impacts of avocado imports from Mexico. The letter highlighted reports of illegal deforestation and unsustainable water use in Michoacán and Jalisco, the states that supply avocados to the U.S. market. Citing environmental degradation, the senators proposed using the pre-existing regulatory framework to additionally certify that avocados do not come from formerly deforested areas. They wrote that the Biden administration “should consider expanding the certification requirement” to review deforestation impacts, but that “because most Mexican avocado orchards are not on recently deforested land, the administration could implement policy changes without significantly reducing U.S. consumers’ access to avocados or harming the livelihood of law-abiding avocado farmers.”

The senators’ letter comes at a time when reducing deforestation driven by agriculture is increasingly a policy priority, as the impacts of deforestation are not only local but also global. Deforestation can reduce biodiversity and impact ecosystems, degrade soils, lead to soil erosion, and increase the risks of flooding. In some areas, deforestation may bring humans into closer proximity to wildlife and zoonotic diseases, increasing the likelihood of pandemics. On a global level, forests store carbon. Deforestation releases this stored carbon directly into the atmosphere and reduces the planet’s ability to sequester carbon dioxide, thereby contributing to climate change.

From 1990 to 2020, Latin America has experienced some of the worst deforestation globally. Total forest area in Latin American countries has declined by 9% according to the United Nations Food and Agriculture Organization (FAO). The Amazon rainforest has lost 36% of its forest cover according to some estimates. From 2000 to 2023, Mexico lost roughly 10% of its forest cover. With this backdrop, much attention has been focused on the role avocado production plays in deforestation in Mexico. After all, Mexico is the birthplace of the fruit, and the avocado is Mexico’s largest agricultural export by value.

The United States is the largest global consumer of avocados, with roughly 3 billion pounds consumed in 2023. It is also one of the largest consumers of Mexican avocados, representing 80% of its exports and representing 42% of Mexico’s total production. Based on our analysis of the U.S. Department of Agriculture’s Agricultural Marketing Service (USDA AMS) data, between 2018–2022, Mexican avocados com-

posed 78% of total U.S. consumption, while domestically grown avocados from California, where deforestation risks are minimal, represented roughly 12%. Given how tightly linked U.S. consumption is with Mexican production, a natural question is whether U.S. demand has contributed to forest loss in Mexico. This makes avocados an important case study for U.S. trade policy on deforestation.

The United States started allowing imports of Mexican avocados in some capacity in 1997, and Mexican exports of the fruit have grown apace. In that year, Mexico exported 115 million pounds of avocados, representing less than 4% of the country’s production. Over the coming years, total Mexican production more than tripled from 1.7 billion pounds in 1997 to 5.8 billion pounds in 2023. In 2023, U.S. imports of avocados from Mexico totaled nearly 2.5 billion pounds, according to the USDA’s Foreign Agricultural Service (FAS). Even though the United States now imports large quantities of Mexican avocados, the U.S. restrictions on avocado imports act as trade barriers and limit avocado imports from Mexico.

The process to apply for export certification for an avocado orchard is costly, and the USDA Animal and Plant Health Inspection Service (APHIS) and its Mexican counterpart, the National Service of Agro-Alimentary Health, Safety and Quality (SENASICA), closely monitor the avocado orchards allowed to sell to the United States. The list of USDA APHIS import requirements for avocados is detailed. These requirements include semi-annual surveys by USDA and SENASICA inspectors, strict sourcing and transportation requirements, and

regulations on packing and exporting facilities. Failing to meet these standards can result in noncompliance and decertification.

Despite the USDA APHIS requirements, current bilateral agreements on avocado imports do not account for deforestation, as the aforementioned senators have recommended. The senators base their proposal on a report on avocado-driven deforestation by Climate Rights International (CRI), which documents export-oriented avocado orchards in Mexico linked to illegal deforestation. The same report argues for the feasibility of such standards, noting that some Mexican agencies have called for similar measures.

While the policy may be feasible, its potential implementation is facilitated in large part by the close monitoring of exporting orchards by both the USDA APHIS and SENASICA. Avocado deforestation has been well-studied by groups like CRI because of these export certification requirements, which collect data on exporting orchards as part of the monitoring process. That said, adding deforestation standards to the list of import requirements for avocados may not substantially alter the trajectory of Mexican deforestation.

First, even if stringent deforestation requirements are placed on exporting

orchards, production can be reshuffled so that avocados produced in older orchards go to the United States, and avocados associated with recent deforestation go elsewhere or are consumed domestically. While the United States consumes 42% of all Mexican avocados, the remainder are not monitored. Such reshuffling would be a form of leakage. Leakage happens when environmental regulations only lead to a reshuffling of regulated activities from more regulated settings to less regulated ones—not the direct reductions that regulation is supposed to cause. As in other settings, the potential for leakage implies that even with stringent regulation on U.S. avocado imports, increases in U.S. demand may still drive deforestation. Second, a focus solely on export-oriented avocados ignores other crops produced in Mexico. Compared to avocados, other crops in Mexico are less strictly regulated, and the potential to monitor deforestation associated with their production is lower.

To provide evidence on these points, we analyze Mexican deforestation data using the Hansen Global Forest Change (GFC) dataset. The GFC dataset estimates gross annual losses in forest cover between 2000 and 2023 using satellite-derived observations. Although widely used to monitor deforestation, the GFC dataset has

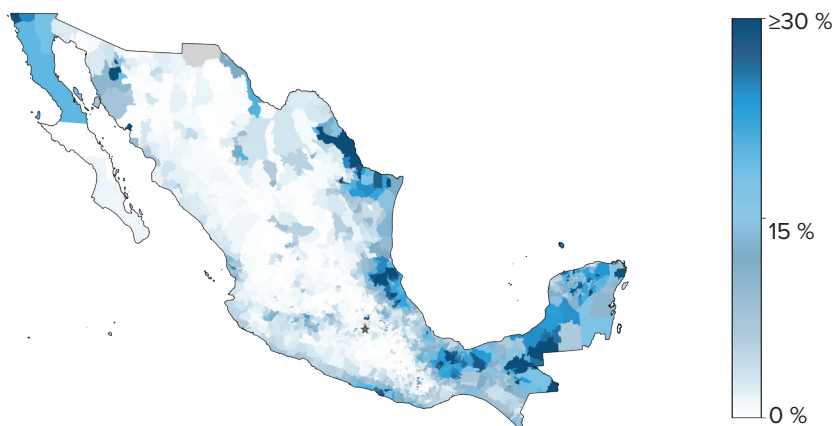
some limitations. It does not distinguish between natural and man-made losses of forest and does not capture reforestation. The dataset is also subject to measurement error inherent in any remotely sensed data product. Therefore, estimates of forest loss from the GFC data should be interpreted as likely upper bounds on the true amount of human-caused deforestation.

In Figure 1, we calculate Mexico's municipal deforestation rates from 2000 to 2023. The highest rates (exceeding 30% in some cases) occur in the Yucatán Peninsula's rainforest areas, the eastern states of Tamaulipas and Veracruz, Baja California, and coastal sections of Guerrero. Some municipalities in the avocado-growing regions of Jalisco and Michoacán appear to have high deforestation rates: The most deforested municipalities have lost more than 22% of their forest cover, while the median municipality in both states lost less than 2%.

We then analyze forest losses across all municipalities that produce export-oriented fruit-bearing perennial crops: avocados, mangoes, coffee, bananas, and lemons. Further, we distinguish between avocado-growing municipalities that export to the United States and those that do not (which includes those who may export to other countries in addition to those who only sell domestically). Our analysis captures total forest loss in the municipalities producing each crop. This means that other crops could actually be the ones grown on deforested lands in the municipality. It also means that we double-count forest losses when municipalities grow more than one of these crops.

Figure 2 illustrates the forest cover loss (in millions of acres) for the Mexican municipalities growing each crop from 2000–2023. Overall, in terms of total forest loss in acres and percentage of total forest lost, avocados are asso-

Figure 1. Deforestation Rates by Mexican Municipality From 2000 to 2023



Source: Authors' calculations based on the Hansen GFC dataset. Available at: <https://bit.ly/3zW16HD>.

ciated with less deforestation at the municipality level compared to other crops in Figure 2. Taking a weighted average across growing municipalities (where we weight each municipality by its share of Mexican production for each crop in 2022), municipalities growing avocados have lost 6.5% of their forest cover. Average losses in avocado-growing municipalities are less than the country-wide average of 10%, and also less than the weighted average in banana-growing municipalities, which have lost more than 11% of their forest cover. When we differentiate between avocado-growing municipalities that export to the United States versus ones that do not, we find higher deforestation rates in U.S. exporting municipalities (around 7% versus 4%). Even though U.S.-exporting municipalities have lost fewer acres of forest, the losses represent a larger share of their forest cover, which had fewer forested acres initially in 2000.

Our analysis shows that tackling Mexican deforestation means expanding policy beyond U.S. export-oriented avocado orchards. Avocado production destined for the United States may have displaced production for domestic markets, potentially increasing the demand for new land for avocados elsewhere. This kind of deforestation leakage would not be halted by restricting U.S. imports from deforested lands. Even stringent deforestation regulations on avocados will not prevent deforestation associated with other crops, many of which are linked to higher average forest cover loss.

Deforestation Policy on the Rise

Responding to concerns about deforestation linked to agricultural imports, the European Union (EU) has discussed initiatives to achieve deforestation-free supply chains for commodities like beef, cocoa, coffee, and palm oil. The UK has held similar conversations via their Forest, Agriculture and Commodity Trade (FACT)

program. Such proposals have faced criticism. Affected trade partners have expressed concerns about their sovereignty and the ability for these proposals to serve as blatant trade barriers.

These concerns have not gone unchallenged on the international stage. A recent ruling by the World Trade Organization (WTO) highlighted the complexities of balancing environmental standards against trade rights. The WTO adjudicated on a complaint by Malaysia against the EU's decision to declassify palm oil-based biodiesel as renewable due to deforestation concerns. The panel mostly sided with the EU, illustrating that while such measures can withstand legal scrutiny, they must comply with international trade laws and not act primarily as trade barriers.

U.S. Policy Responses

On the domestic front, the Biden administration released Executive Order 14072 in April 2023. The order commits to actions such as taking stock of forest cover, spending more on wildfire mitigation, and developing policies for reforestation. Responding to the executive order, the State Department released two reports in April 2023. The first addresses U.S. involvement in the purchase of agricultural commodities that contribute to deforestation. It discusses the feasibility of potential

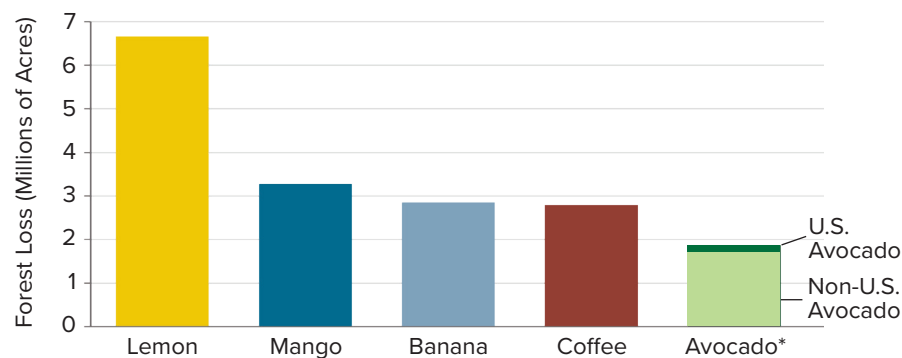
policies and steps to address leakage. The second report addresses policy instruments to reduce global deforestation. These include incorporating deforestation policy into foreign aid and multilateral and bilateral trade agreements.

In November 2023, the Senate reintroduced the FOREST Act. The act would combat illegal deforestation by prohibiting the importation of products made from commodities produced on formerly deforested land. In contrast with the State Department reports, the act targets specific commodities such as palm oil, cattle, cocoa, and rubber. It authorizes the U.S. Trade Representative to annually update the list of targeted commodities.

Economics of Deforestation Policies

Potential policies to address deforestation are a mix of demand-side policies that increase the costs of importing crops associated with deforestation, and supply-side policies that incentivize the preservation of forests. Demand-side policies like trade restrictions face two unique challenges. First, importing countries need to be able to determine which products are associated with deforestation. This requires tracking and certifying products through entire supply-chains. The example of Mexican avocado imports

Figure 2. Decrease in Mexican Forest Cover Across Producing Municipalities (2023 vs. 2000)



Source: Authors' calculations based on the Hansen GFC dataset.

Note: Bar height represents total forest loss from 2000–2023 in all municipalities that grow a given crop. *U.S. Avocado=municipalities that export avocados to the United States; Non-U.S. Avocado=municipalities that produce avocados either for export to other countries or to sell domestically.

shows that while possible, this is also costly, and it requires officials to closely monitor exporting orchards. Similar policies for other crops would likely lead to increased costs for U.S. consumers. Further, since regulation tends to increase fixed costs, it could lead to consolidation of producers.

Second, as discussed previously, demand-side deforestation policies face the issue of leakage. In the worst case, increased demand for deforested products could be met by reshuffling existing production, clearing more forests, and sending deforested production to destinations without regulation. The underlying causal relationships can be complex. For example, the recent work of Domínguez-Iino shows that while recently deforested lands in the Amazon are used for cattle ranching, cattle ranching itself is being displaced by soybean production, some of which goes towards incremental U.S. biofuel demands. To sum up, more important than whether U.S. imports come directly from deforested lands, is whether a trading partner's total acreage of forests is rising or falling—and the degree to which additional exports to the U.S. are causing deforestation.

Supply-side policies like payments for ecosystem services and foreign assistance that reduce the opportunity cost of preserving forests face their own challenges. For example, it is hard to ensure additionality—in other words, that payments actually cause decreases in deforestation that would otherwise occur.

Recent work by Harstad proposes an approach that circumvents some of the challenges associated with demand-side deforestation trade policy. Under Harstad's approach, an importing country can impose tariffs based on an exporter's change in the total forest acreage. This avoids issues associated with tracing supply chains, leakage, and focusing on

some kinds of deforestation but not others. Similarly, Hsiao has shown that careful import trade policy can effectively combat deforestation and substitute for domestic deforestation policy in producing countries. These approaches highlight the principle that policy should target the broad problem—deforestation—and not a smaller subset, such as exports of avocados to the United States grown on deforested lands. Illustrating this point, we find that deforestation in U.S. avocado-exporting municipalities is only 1.4% of total Mexican deforestation from 2000–2023.

Implications for Californians

Insofar as demand-side or supply-side deforestation policies reduce the supply of avocado imports to the United States—or any other agricultural imports, for that matter—deforestation policies will raise prices for U.S. producers and consumers. California producers, who grow the same crops as foreign producers on parcels of land largely without pre-existing forest cover, would stand to benefit. In a sense, deforestation policies may bring imports in line with domestic sustainability standards. However, policies that certify imports as deforestation-free may also act as attributes that increase consumers' willingness-to-pay for sustainable goods. U.S. retailers and importers have taken an interest in ensuring that their supply chain is deforestation free. This requires costly monitoring. Federal monitoring could replace these efforts and lower costs for individual firms while maintaining a consistent standard.

The costs of demand-side policies could vary widely. Demanding certification processes on individual commodities would raise fixed costs and barriers to entry, leaving out small farmers from export markets. Stringent requirements for the remainder of the supply chain would raise variable

costs. If certification processes are violated, this could even result in import bans of commodities, which could hurt California agricultural intermediaries, who often source their supply from California as well as Mexico and other countries. Simple demand-side policies—such as Harstad's proposed deforestation tariff—may have lower implementation costs and could help overcome issues like leakage. Ultimately, economics advocates for achieving greater environmental benefits—less deforestation—at the lowest cost to both U.S. consumers and producers.

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For additional information, the authors recommend:

Domínguez-Iino, Tomás. 2023. "Efficiency and Redistribution in Environmental Policy: An Equilibrium Analysis of Agricultural Supply Chains." Working Paper. Available at: <https://bit.ly/4ffZngE>.

Harstad, Bård. 2022. "Trade, Trees, and Contingent Trade Agreements." CESifo Working Paper No. 9596. Available at: <https://bit.ly/3Y66Qsp>.

Hsiao, Allan. 2024. "Green Trade Policy for Palm Oil." VoxDev article. Available at: <https://bit.ly/4feutVZ>.